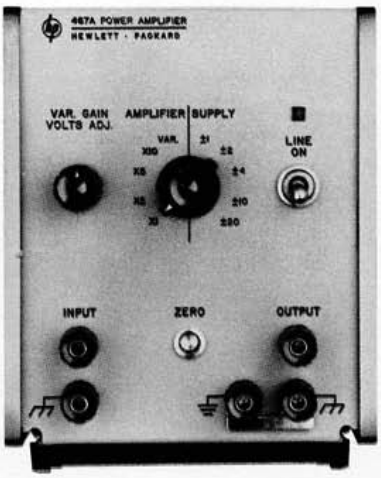
OPERATING AND SERVICE MANUAL

HP 467A

POWER AMPLIFIER/SUPPLY

467A



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CERTIFICATION

The Hewlett-Packard Company certifies that this instrument was thoroughly tested and inspected and found to meet its published specifications when it was shipped from the factory. The Hewlett-Packard Company further certifies that its calibration measurements are traceable to the U.S. National Bureau of Standards to the extent allowed by the Bureau's calibration facility.

WARRANTY AND ASSISTANCE

All Hewlett-Packard products are warranted against defects in materials and workmanship. This warranty applies for one year from the date of delivery, or, in the case of certain major components listed in the operating manual, for the specified period. We will repair or replace products which prove to be defective during the warranty period provided they are returned to Hewlett-Packard. No other warranty is expressed or implied. We are not liable for consequential damages.

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OPERATING AND SERVICE MANUAL

(HP PART NO. 00467-90003)

MODEL 467A
POWER AMPLIFIER/SUPPLY

SERIALS PREFIXED: 444-

P.O. Box 301, Loveland, Colorado, 80537 U.S.A.

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Table 1-1. Specifications

POWER AMPLIFIER

Voltage Gain (non-inverting):
Fixed steps: X1, X2, X5, X10.
Variable: 0-10, resolution is better than 0.1% of full output.

Accuracy: ±0.3% from dc to 10 kHz with load of >40 Ω; ±1.0% from dc to 100 kHz; ±10% from dc to 1 MHz.

Output Capability: ± 20 V peak at 0.5 A peak.

Distortion: Less than 0.01% at 1 kHz; less than 1% at 100 kHz; less than 3% at 1 MHz. For full rated output.

Input Impedance:
50 kΩ shunted by 100 pF.

DC POWER SUPPLY

Voltage Range: greater than ± 20 V, ±10 V, ±4 V, ±2 V, ±1 V, with continuously variable vernier between ranges with resolution better than 0.1% of full output.

Current: ±0.5 A peak.

Load Regulation (front panel connector): Less than 10 mV for load change from 0 to 0.5 A.

Line Regulation: Less than 10 mV for a ±10% change in line voltage.

GENERAL

Output Impedance (front panel connector):
Nominal: 5 mΩ in series with 1 μH.

Capacitive Load: 0.01 μF or less does not cause instability.

Ripple and Noise: Less than 5 mV peak-to-peak when referred to output for all gain positions and power supply outputs.

Current Limit: <800 mA.

Temperature Coefficient: Less than 0.05%/°C or ±2 mV/°C, whichever is greater.

Input-Output Terminals:

Front Panel: 3/4" Banana terminals for input, output, and chassis.
Rear Panel: BNC terminalsfor input and output.
Circuit Ground: May be floated 200 Vdc above chassis.

Operating Temperature Range: 0°to +50°C.

Weight: Net 10 lbs. (4,5 kg).

Power Required: 115 or 230 V ±10%, 50 to 400 Hz; <35 W at full load.

Dimensions:

Width: 5-1/8" (130 mm).
Height: 6-1/2" (165 mm).
Depth: 11" (279 mm).

SECTION I
GENERAL INFORMATION

1-1. DESCRIPTION.

1-2. The solid state 467A Power Amplifier/Supply is a 10 watt peak power amplifier and -20 to +20 volt dc power supply. The power amplifier has a wide bandwidth with low dc drift from dc to 1 MHz offering wide applications wherever a power source is required. Low distortion (<0.01%), low drift and 0.3% gain accuracy are obtained with high quality components and multiple feedback techniques. The gain of the amplifier may be varied between one and ten by a front panel switch which provides fixed gain steps accurate to ±0.3%. A variable gain control enables the user to set the gain anywhere between zero and ten with a resolution of better than 0.1% of full output. Table 1-1 gives the specifications for the 467A Power Amplifier/Supply.

1-3. OUTPUT CAPABILITY.

1-4. An output greater than 20 volts peak and 0.5 ampere peak is available from dc up to 1 MHz. The amplifier is protected at all times from short circuits. The input circuit of the 467A is protected against damage from voltages up to 200 volts p-p. Input and output connectors are provided at the front and rear of the instrument. The amplifier is a three terminal device isolated from chassis and may be floated up to 200 volts dc above chassis ground.

1-5. POWER SUPPLY.

1-6. A front panel switch converts the amplifier to a power supply that delivers ±20 volts dc at currents up to ±0.5 ampere. The output level is controlled by a potentiometer which permits voltages to be set with resolution of 0.1% of full scale. Full scale ranges of ±1, ±2, ±4, ±10, and ±20 volts are selected by the front panel range switch.

1-7. INSTRUMENT IDENTIFICATION.

1-8. Hewlett-Packard uses a two-section eight-digit serial number (000-00000). If the first three digits of the serial number on your instrument do not agree with those on the title page of this manual, change sheets supplied with the manual will define differences between your instrument and the Model 467A described in this manual.

SECTION II
INSTALLATION

2-1. INSPECTION.

2-2. Upon receipt, unpack and inspect the instrument for mechanical and electrical damage. Mechanical inspection includes visually checking the instrument for scratched and warped surfaces, damaged control knobs, switches, and indicators, and signs of weather exposure. The electrical inspection involves checking instrument operation against specification values given in Table 1-1. Refer to Paragraph 5-5.

NOTE

In case of mechanical damage, file a claim with the carrier immediately. If an electrical malfunctionoccurs, refer to the warranty page in the front of this manual.

2-3. INSTALLATION.

2-4. The Model 467A is a submodular unit that can be mounted on a bench, or in a rack or cabinet. It is shipped with plastic feet and tilt stand in place, ready for bench use. When used as a single submodule, it is utilized as a bench unit only. When used in combination with other submodule units, a rack adapter frame or combining case is available for rack or cabinet mounting. The instrument should be installed where ambient temperature does not exceed 50°C (122°F).

2-5. POWER REQUIREMENTS.

2-6. The Model 467A can be operated from a 115 or 230 ac volt ±10% source at 50 to 400 Hz. Power connections are made by plugging the power cable (supplied with the instrument) into the AC POWER male connector at the rear of the unit and the appropriate power receptacle. An 0.8 ampere slow-blow fuse is used for 115 and 230 volt operation.

CAUTION

BEFORE PLUGGING POWER CABLE INTO THE RECEPTACLE, DETERMINE THAT THE LINE VOLTAGE SWITCH ON THE REAR PANEL IS SET PROPERLY TO ACCEPT THAT VOLTAGE (115 OR 230).

2-7. THREE-CONDUCTOR POWER CABLE.

2-8. All Hewlett-Packard instruments are equipped with a three-conductor power cable, which complies with the recommendations of the National Electrical Manufacturer's Association (NEMA) for rack and cabinet grounding. The offset pin on the cable is the ground connector.

NOTE

When operating from a two-contact outlet, the grounding feature can be maintained by using a three-pronged adapter and connecting the green pigtail on the adapter to ground.

2-9. REPACKAGING FOR SHIPMENT.

2-10. The following paragraphs contain a general guide for repackaging of the instrument for shipment. Refer to Paragraph 2-11 if the original container is to be used; 2-12 if it is not. If you have any questions, contact your local -hp- Sales and Service Office. (See Appendix B for office locations.)

NOTE

If the instrument is to be shipped to Hewlett-Packard for service or repair, attach a tag to the instrument identifying the owner and indicating the service or repair to be accomplished; include the model number and full serial number of the instrument. In any correspondence, identify the instrument by model number, serial number, and serial number prefix.

2-11. If original container is to be used, proceed as follows:

a. Place instrument in original container if available. If original container is not available, one can be purchased from your nearest -hp- Sales and Service Office.

b. Ensure that container is well sealed with strong tape or metal bands.

2-12. If original container is not to be used, proceed as follows:

a. Wrap instrument in heavy paper or plastic before placing in an inner container.

b. Place packing material around all sides of instrument and protect panel face with cardboard strips.

c. Place instrument and inner container in a heavy carton or wooden box and seal with strong tape or metal bands.

d. Mark shipping container with "DELICATE INSTRUMENT," "FRAGILE" etc.

SECTION III
OPERATING INSTRUCTIONS

3-1. GENERAL.

3-2. The Model 467A Power Amplifier/Supply can be operated as a power amplifier or a power supply. Controls on the front panel provide: (1) selection of either operating mode and (2) selection of fixed or variable amplifier gain and power supply ranges.

3-3. DESCRIPTION OF CONTROLS.

3-4. Figure 3-1 gives the description and function of the 467A controls, indicators and connectors.

3-5. OPERATING INSTRUCTIONS.

3-6. When operated as a power amplifier (non-inverting), the Model 467A has four calibrated gain factors (AMPLIFIER: X1, X2, X5, and X10) and provides a maximum output power of 10 watts peak for input frequencies between dc and 1 MHz. Accuracy of ±0.3% from dc to 10 kHz is obtained when operating into a load of 40 ohms or greater. As a power supply (regulated), the instrument can be operated in five ranges of plus or minus output voltages (SUPPLY: ±1, ±2, ±4, ±10, and ±20). The amplifier gain, or the ± dc output can be varied with the VAR. GAIN/VOLTS ADJ. control. The input and output terminals are dc isolated from earth ground. Connection of a grounding strap between the power line ground (⏚) and (⏚) terminals references both the INPUT and OUTPUT (⏚) terminals to earth ground.

3-7. AMPLIFIER OPERATING INSTRUCTIONS.

a. Set the AMPLIFIER/SUPPLY control to the AMPLIFIER position, selecting the desired gain setting (VAR., X1, X2, X5, or X10).

b. Set the LINE switch to ON.

NOTE

To assure maximum stability, allow the instrument to warm up for 30 minutes.

c. Connect DC Voltmeter (-hp- Model 412A) to the 467A OUTPUT terminals; adjust the ZERO control to obtain a zero dc output.

d. Connect the 467A OUTPUT terminals to the device to which the amplified signal is being applied.

e. Connect the signal to be amplified to the 467A INPUT terminals.

3-8. POWER SUPPLY OPERATING INSTRUCTIONS.

a. Connect the 467A OUTPUT terminals to the device to which the power supply is being applied.

b. Set 467A AMPLIFIER/SUPPLY control in the SUPPLY range to the desired voltage setting (±1, ±2, ±4, ±10, or ±20).

c. Set the LINE switch to ON.

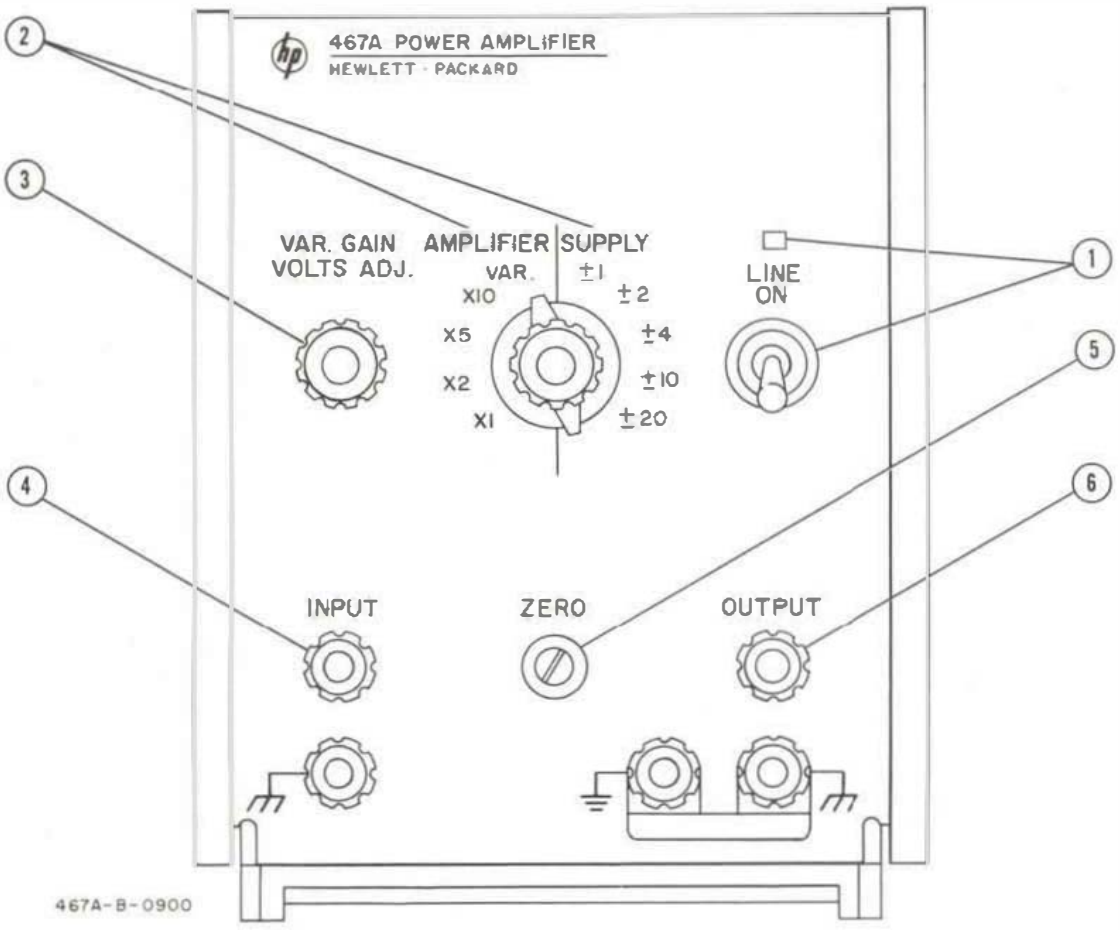
NOTE

To assure maximum stabilization, allow the instrument to warm up for 30 minutes.

d. Using the VAR. GAIN VOLTS ADJ. control, adjust the voltage to the desired level.

NOTE

The VAR. GAIN VOLTS ADJ. control is used for both coarse and fine adjustments. Coarse adjust is made after either limit of the fine adjust is reached. Full CCW position produces maximum negative voltage. Full CW position produces maximum positive voltage.



(1) LINE ON: switches voltage on; indicator glows when ac line voltage is ON.

(2) AMPLIFIER/SUPPLY: selects power amplifier or power supply mode of operation for the instrument.

AMPLIFIER (X1, X2, X5, X10): selects the fixed step gain factor.

AMPLIFIER (VAR.): operates in conjunction with VAR. GAIN to provide variable control of amplifier gain anywhere between zero and X10.

SUPPLY: selects full scale ranges of ±1, ±2, ±4, ±10, or ±20 volts.

(2) VAR. GAIN/VOLTS ADJ.: operates in conjunction with AMPLIFIER/SUPPLY control to provide variable control of amplifier gain or selection of ± dc output voltage.

VAR. GAIN: operates in conjunction with AMPLIFIER (selector in VAR. position) to provide variable control of amplifier gain anywhere between zero and X10.

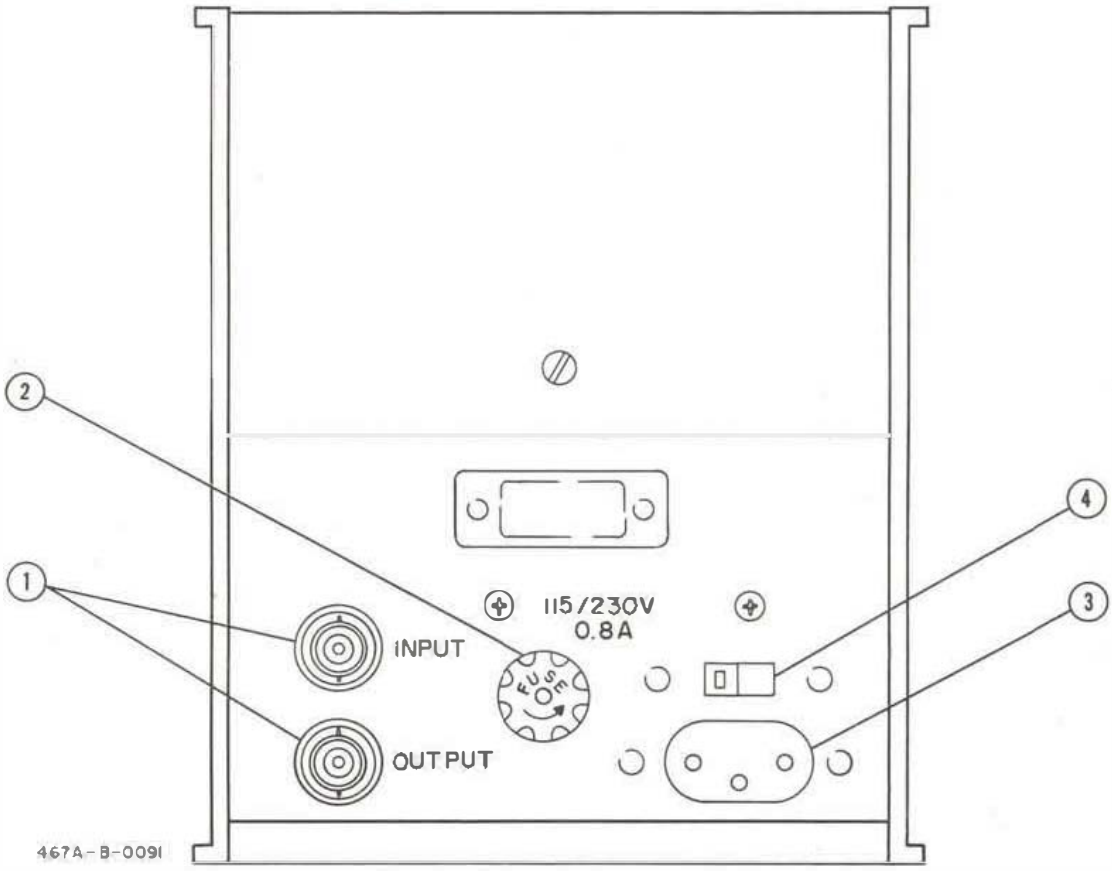
VOLTS ADJ.: operates in conjunction with SUPPLY control position to provide variable control of dc output voltage anywhere between 0 volts and ±20 volts.

(4) INPUT: banana-type connectors that provide signal input and circuit common input connections for the instrument.

(5) ZERO: a screwdriver adjust that provides compensation for dc offset, or unbalance, with no signal applied to the 467A INPUT terminals.

(6) OUTPUT: banana-type connectors that provide signal output, circuit common, and chassis output connections for the instrument.

Figure 3-1. Front panel Controls, Indicators and Connectors



(1) INPUT and OUTPUT connectors; these BNC connectors are connected in parallel with the INPUT and OUTPUT terminals on the front panel.

(2) FUSE: contains a fuse which provides protection for the primary circuit of the instrument power transformer. This fuse is used for both 115 v and 230 v operation.

(3) Power Connector: accepts a 3-wire power cable with safety ground.

(4) Line Voltage: a two-position slide switch; sets the 467A for 115 or 230 volt operation.

Figure 3-2. Rear Panel Controls and Connectors

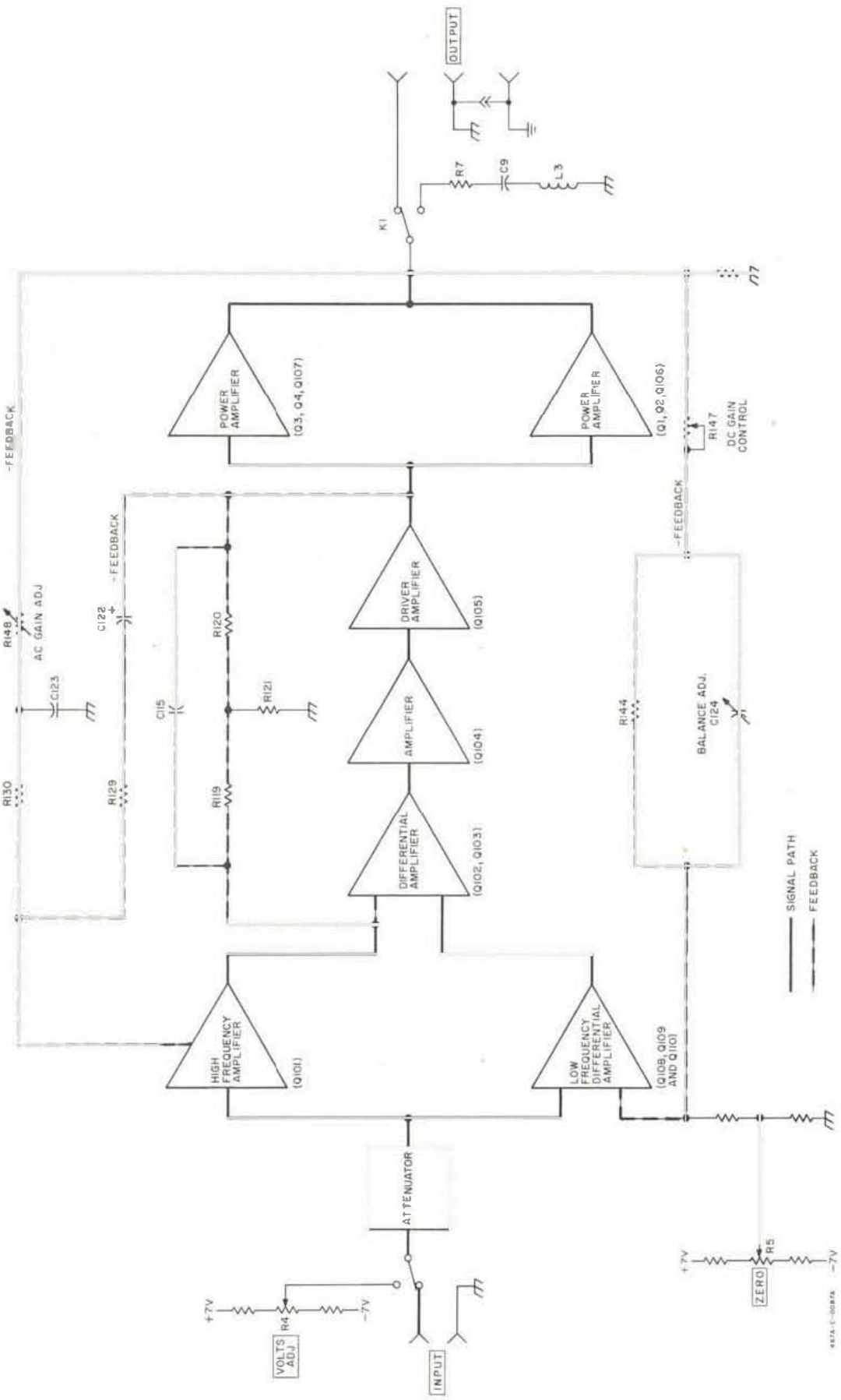


Figure 4-1. Simplified Block Diagram

SECTION IV
THEORY OF OPERATION

4-1. INTRODUCTION.

4-2. The Model 467A Amplifier circuits include a high frequency amplifier, a low frequency amplifier, a two-stage differential amplifier, a driver amplifier, and two power amplifier stages. These circuits provide two modes of operation, the power amplifier mode and the power supply mode.

4-3. When the AMPLIFIER/SUPPLY switch is in the AMPLIFIER position, the gain can be set in fixed steps of X1, X2, X5 and X10. When the switch is in the AMPLIFIER/VAR position, the VAR GAIN/VOLTS ADJ control can be used to set the amplifier gain to any value between zero and ten. The input signal is applied to the attenuator, which selects the gain to be used by the instrument amplifier circuitry. Ac and dc feedback stabilize the amplifier gain. Compensation for dc offset, or unbalance, is provided by a ZERO adjust control on the front panel.

4-4. When the AMPLIFIER/SUPPLY switch is in the SUPPLY position, the amplifier provides five power supply voltage ranges: ±1, ±2, ±4, ±10 and ±20 volts, variable from plus through zero to minus for each range. An internal dc reference voltage (plus or minus) is applied to the amplifier portion, which provides a regulated dc voltage at the OUTPUT terminals of the instrument.

4-5. BLOCK DIAGRAM DESCRIPTION.

4-6. Figure 4-1 shows the block diagram for the 467A. The input signal is applied to the high and low frequency amplifiers. The high frequency amplifier (Q101) amplifies the ac signal; the low frequency amplifier (Q108 through Q110) amplifies the dc and low frequency signals. The amplified input signal is then applied through the differential amplifier (Q102 and Q103), amplifier (Q104), and driver amplifier (Q105) to emitter followers (Q106 and Q107). Power amplifiers Q1 and Q2 (driven by Q106) and Q3 and Q4 (driven by Q107) provide a balanced signal to the OUTPUT connectors.

4-7. At frequencies above 1 MHz, negative feedback from the driver amplifier Q105 is applied to Q101 through C122 and R129 to provide a decrease in distortion and remove the power amplifiers from the feedback loop. Negative feedback from Q105 is applied to differential amplifiers Q102 and Q103 through R120, C115 and R119 to improve frequency response of the instrument. Gain control for high frequency amplifier Q101 is supplied from the output of the power amplifiers (Q1 through Q4) through R148 and R130.

4-8. At frequencies between dc and 50 KRz, negative feedback from the output provides dc gain control and balance adjust for the low frequency amplifiers Q108 through Q110. ZERO adjust R5 provides compensation for dc unbalance of the signal applied to the low frequency amplifiers. Relay K1 protects the external load against current surges during turn-on and turn-off.

4-9. SCHEMATIC DIAGRAM DECRIPTION.

4-10. The following paragraphs give a detailed description of the Model 467A Amplifier circuits. Refer to Figures 5-13 and 5-14, Section V, for the schematic diagrams of the instrument.

4-11. HIGH FREQUENCY AMPLIFIER.

4-12. Trimmer capacitors C301, C303 and C305 can be adjusted to provide the desired frequency response characteristics for the instrument. Ac input signals from the attenuator are applied through C101 to the high frequency amplifier Q101. The signal is amplified by Q101 and coupled through C104 to the base circuit of Q102. The RC networks, C105, R112, C106 and R114 are used to improve the frequency response characteristics of the amplifier Q102. The bias voltage of Q101 is determined by resistive divider R103 and R104. Ac feedback from power amplifiers (Q1, Q2, Q3, and Q4) is applied through R148 to provide ac gain adjust for Q101.

4-13. LOW FREQUENCY AMPLIFIER.

4-14. When the AMPLIFIER/SUPPLY selector is in the SUPPLY position, +7 and -7 volts are supplied from an internal reference, through resistive dividers, to the amplifier input. Each SUPPLY position (±1, ±2, ±4, ±10 and ±20) permits setting the dc output voltage to any ± value within the range selected. The low frequency amplifier circuit (Q108, Q109 and Q110) amplifies the dc and low frequency input signal and drives Q103. The bias voltage for the low frequency amplifier is controlled by R132 and R133 and the ZERO control R5. Transistor Q110 is a current source for the differential amplifiers Q108 and Q109. Inductors L101 and L102 control the frequency response of the low frequency amplifier (at higher frequencies) by causing degeneration of Q108 and Q109 emitters. High frequencies present at Q109 collector are shorted to ground by C109. Low frequency stabilization and overall amplifier gain (between dc and 50 KHz) are provided by applying dc feedback from the OUTPUT to Q109 base. The ZERO potentiometer R5 provides an adjustment to compensate for dc drift in the instrument. Varying R5 changes the voltage at Q109 base, thereby changing the output level of the low frequency amplifier.

4-15. DIFFERENTIAL AMPLIFIER.

4-16. Differential amplifiers Q102 and Q103 provide an output proportional to the input signals from the high frequency amplifier Q101 and the low frequency amplifier circuit (Q109 and Q110). The high frequency ac signals are coupled to Q102 through C104; the dc and low frequency signals from the low frequency amplifier are direct-coupled to differential amplifier Q103. Capacitor C108 bypasses any high frequency ac from the low frequency amplifier to

ground. C109 bypasses any high frequency signals present at the base of Q103. Ac feedback from Q105 collector circuit is applied through C115 to the base circuit of Q102 for high frequency gain stabilization.

4-17. VOLTAGE AMPLIFIER.

4-18. The voltageamplifier Q104 supplies the majority of the voltage gain for the instrument. Degeneration at low frequencies is provided by R127 in the Q104 emitter circuit; C116 provides added phase stability at high frequencies. Current through R125 provides the bias current for Q105. Breakdown diode CR104 establishes the proper voltage at Q104 collector and maintains a dc signal path from Q104 Collector to Q105 base.

4-19. DRIVER AMPLIFIER.

4-20. Driver amplifier Q105 is driven by current amplifier Q104 and supplies the signal to the power output amplifiers. Transistors Q106 and Q107 are forward biased by diodes CR108 through CR112 and under no-signal condition are conducting slightly to reduce cross-over distortion in the output signal.

4-21. OUTPUT CIRCUITS.

4-22. Transistors Q1 through Q4 provide a complementary symmetry output. Q1 and Q2, driven by emitter follower Q106, provide a low output impedance. Q3 and Q4, driven by Q107, form a unity gain feedback amplifier. This causes Q3 and Q4 to act as a PNP emitter follower, which is necessary to provide the complementary symmetry output.

4-23. EXTERNAL LOAD PROTECTION.

4-24. The external load connected to the 467A is protected during turn-on and turn-off, from current surges and voltage transients, by relay K1. The relay contacts open the circuit to the OUTPUT connectors when the relay is de-energized. When the instrument is turned ON, K1 remains de-energized for about 300 milliseconds. This delay permits the instrument to stabilize before the output is connected to the load. The 300 millisecond delay is caused by the RC time constant of C110 and R161. When the instrument is turned off, the relay quickly de-energizes and opens the circuit to the OUTPUT connector.

4-25. POWER SUPPLY CIRCUIT DESCRIPTION.

4-26. The 467A primary power supply consists of two regulated power supplies (-34 and +34 volts), and five reference supplies (+7, -7, +15, -15 and +30 volts). Either 115 or 230 volts ac is connected to the instrument through switch S1 and fuse F1 to T1 primary. Switch S2 (slide switch on rear panel) connects T1 primary windings in series for 230 volt operation, or in parallel for 115 volt operation. The LINE ON lamp DS1 glows when primary power is applied to the instrument.

4-27. MINUS 34 VOLT SUPPLY.

4-28. Transistor Q112 in conjunction with R156, CR129, and CR130 provide a constant current source which provides base drive for Q5 and Q6. Q112 also provides current to keep CR131, CR132, CR133, and CR135 conducting. R2 and Q5 share the load current to reduce the dissipation in Q6. For small load currents Q5 is turned off and resistor R2 supplies the current. As the load current increases, the base of Q5 is forward biased and Q5 conducts, sharing the current. As the load current is increased further, CR134 is forward biased at a current level determined by R159. This will reduce the current in CR135 to zero causing the supply voltage to go to zero also.

4-29. PLUS 34 VOLT SUPPLY.

4-30. The +34 volt supply provides regulated voltage to the power amplifier circuits. Breakdown diode CR143 establishes the reference at the base of Q8. Potentiometer R163 adjusts the current limit setting for the +34 volt supply.

4-31. REFERENCE SUPPLY.

4-32. The diode regulated reference supply (refer to Figure 5-14) provides +7, -7, +15 and -15 voltages. Capacitors C126 and C128 filter the ac voltages. Breakdown diodes CR146 and CR147 maintain a +15 reference voltage at the junction of R149 and R150. The series arrangement of diodes CR120 and CR121 (forward biased diodes) and CR122 and CR123 (reverse biased diodes) compensates for temperature and provides a constant -15 reference voltage at the junction of R151 and R152. The plus and minus 7 volt reference voltages are obtained in the same manner as the plus and minus 15 reference voltages. Series regulator Q111 provides regulated +30 volts to the positive side of the reference supply.

Table 5-1. Test Equipment Required

Instrument	Critical Specifications	Use	Recommended Model
DC Voltmeter	Accuracy: ± 0.05 Range: 1000 mV to 100 V	Performance Checks Calibration	-hp- Model 3440A/3444A Digital Voltmeter
Oscillator	Frequency: 10 Hz to 1 MHz Output: 1.0 V Output Impedance: 50 or 600 ohms Distortion: <1%	Performance Checks Calibration	-hp- Model 651B Test Oscillator
AC Voltmeter	Frequency: 10 Hz to 100 KHz Range: 10 V Accuracy: ±0.1 to ±0.3%	Performance Checks Calibration	-hp- Model 3440A/3445A Digital Voltmeter
AC Voltmeter	Frequency: 100 KHz to 1 MHz Range: 0.001 to 30 V Accuracy: ±5%	Performance Checks Calibration	-hp- Model 331A Distortion Analyzer
Variable Line Transformer	Output: 103.5 V to 127.5 V	Performance Checks	Superior Electric Model UC1M
Distortion Analyzer	Frequency: 100 KHz Range: 0.01% to 100% Accuracy: ±3%	Performance Checks	-hp- Model 331A Distortion Analyzer
DC Standard	Output: 1.0 V Accuracy: 0.05%	Performance Checks Calibration	-hp- Model 741B DC Standard
DC Milliammeter (clip on)	Range: 1000 mA Accuracy: ±3%	Performance Checks Calibration	-hp- Model 428B DC Milliammeter
Oscilloscope	Frequency: to 15 MHz	Performance Checks	-hp- Model 140A/1402/1420A
Capacitor	0.01 μF ±10% 200 V	Performance Checks	-hp- Part No. 0160-0304
Resistor	40 ohms ±5% 10 watts	Performance Checks	-hp- Part No. 0815-0028
	2 ohms ±1% 1/2 watt	Performance Checks	-hp- Part No. 0727-0445
	12 ohms ±1% 1/2 watt	Performance Checks	-hp- Part No. 0811-0297
	600 ohms ±1% 1/2 watt	Performance Checks Calibration	-hp- Part No. 0727-0081
Filter	Bandpass: 1 KHz Bandwidth: 50%	Distortion Check	White Instrument Lab. 2645-1K
Filter	Bandpass: 100 KHz Bandwidth: 50%	Distortion Check	White Instrument Lab. 2645-100K

SECTION V
MAINTENANCE

5-1. INTRODUCTION.

5-2. This section contains information necessary for the proper maintenance of the -hp- Model 467A Power Amplifier/Supply. This section provides the necessary Performance Checks, Adjustment and Calibration Procedures, and Troubleshooting Techniques required to accomplish the above objective.

5-3. TEST EQUIPMENT REQUIRED.

5-4. The test equipment required to perform the operations outlined in this section is listed in Table 5-1. This table describes the type of instrument required, critical specifications, type of operation to be conducted, and the recommended model. If the specific model recommended is not available, equipment which meets or exceeds the critical specifications listed may be substituted.

5-5. PERFORMANCE CHECKS.

5-6. The performance checks presented in this section are front panel procedures designed to compare the Model 467A with its published specifications. These operations may be incorporated in periodic maintenance, post-repair, or incoming quality control checks. These operations should be conducted before any attempt is made to adjust or calibrate the instrument. During these operations, the Model 467A power line voltage should be periodically varied ±10%. A fifteen minute warm-up period should be allowed prior to conducting these checks.

5-7. POWER AMPLIFIER OPERATIONS.

5-8. DC GAIN CHECK.

a. A DC Voltmeter (-hp- Model 3440A/3444A) and a DC Standard (-hp- Model 741B) are required for this test.

b. Set the Model 467A to AMPLIFIER X10.

c. Connect the DC Standard output to the Model 467A INPUT. Adjust the voltage output of the DC Standard to 1.000 V on the dc voltmeter. The output of the 467A should be 10.00 V ±0.3%. If not, refer to Paragraph 5-27 for proper adjustment.

d. Set the 467A to AMPLIFIER X5. The 467A output should be 5.000 V ±0.3%.

e. Set the 467A to AMPLIFIER X2. The 467A output should be 2.000 V ±0.3%.

f. Set the 467A to AMPLIFIER X1. The 467A output should be 1.000V ±0.3%.

g. Set the 467A to VAR.; rotate the VAR. GAIN from fully CCW to fully CW. The 467A output should vary from 0 V to 10 V.

5-9. AC ACCURACY AND GAIN CHECK.

a. Figure 5-1 shows the test setup recommended. A Test Oscillator (-hp- Model 651B), an AC Voltmeter (-hp- Model 331A and 3440A/3445A), 40 and 600 ohm loads are required. Use the 331A Voltmeter for the 1 MHz frequency. Use a 3440A/3445A with known accuracy at 400 Hz and 10 kHz.

b. Connect the 600 ohm load resistor across the 600 ohm OUTPUT of the oscillator. Connect to the INPUT of the Model 467A. Set 651B ATTENUATOR to 1V and FREQUENCY to 100 kHz.

c. Connect the 3445A INPUT to the INPUT of the 467A (A in Figure 5-1). Advance the AMPLITUDE of the Oscillator until the ac voltmeter reads 1.000V.

d. Using a 40 Ω load resistor, connect the 3445A INPUT to the OUTPUT of the 467A (B in Figure 5-1). Set 467A to AMPLIFIER X10. The ac voltmeter should read 10.00 volts ±1.0%. If the reading is not within tolerance, see Paragraph 5-30 for adjustment.

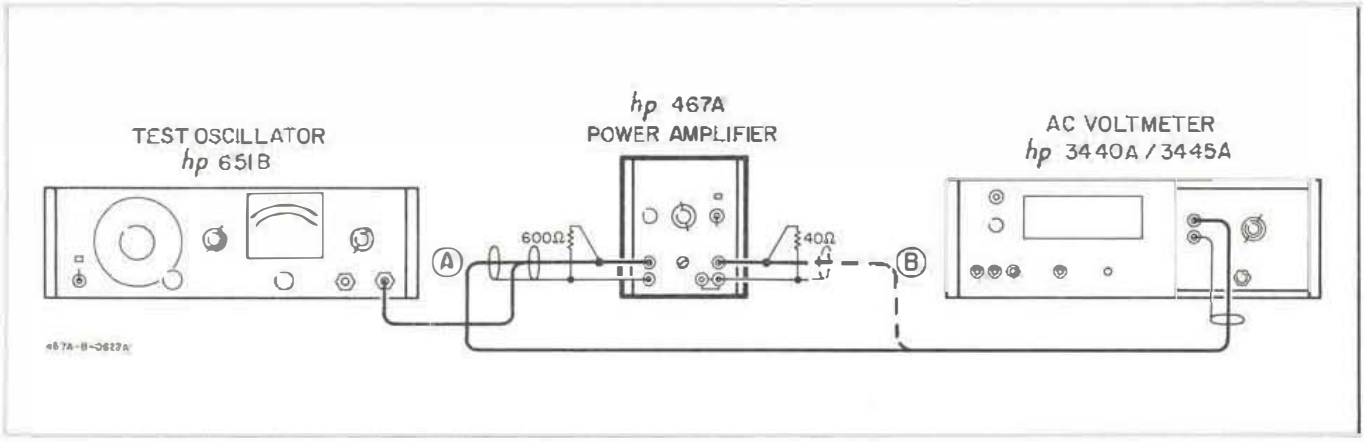


Figure 5-1. AC Accuracy and Gain Check

e. Repeat steps b through d for each of the oscillator settings and Amplifier settings listed in Table 5-2. For each measurement, connect the ac voltmeter first to the INPUT of the 467A and adjust for 1.000 V. Then connect the ac voltmeter to the OUTPUT of the 467A. The reading should be between the limits listed in the last column. If not, see adjustment procedures, Paragraphs 5-28 through 5-30. For 1 MHz output frequency, use 331A AC Voltmeter.

5-10. OUTPUT CAPABILITY CHECK.

a. A Test Oscillator (-hp- Model 651B), an AC Voltmeter (-hp- Model 331A) and 40 ohm and 600 ohm load resistors will be required.

b. Connect the Model 467A as shown in Figure 5-2.

c. Set ac voltmeter RANGE to 30.

d. Set Model 467A to AMPLIFIER X10.

e. Set test oscillator frequency to 400 Hz. Adjust oscillator output amplitude to provide ac voltmeter reading of 14.14 V rms (20 V peak). Current through 40 ohm resistor will then be 0.3535 amps (0.5 A peak).

5-11. DISTORTION CHECK.

a. Figure 5-3A describes the test arrangement recommended. A Distortion Analyzer (-hp- Model 331A), an Oscillator (-hp- Model 651B), a 1 KHz Bandpass Filter (White Instrument

Table 5-2. AC Calibration and Gain Check

Model 651B Oscillator				Model 467A	Model 3440A/3445A AC Voltmeter Reading
Frequency Dial	Range	Output Attenuator	Amplifier Adjusted for 3445A Reading of:	Amplifier	(Output of 467A)
1	X100 K	3	1.000 V	X10 X5 X2 X1 VAR-CW	9.900 to 10.100 V 4.950 to 5.050 V 1.980 to 2.020 V 0.990 to 1.010 V greater than 10 V
1	X10 K	3	1.000 V	X10 X5 X2 X1 VAR-CW	9.970 to 10.030 V 4.985 to 5.015 V 1.994 to 2.006 V 0.997 to 1.003 V greater than 10 V
4	X100	3	1.000 V	X10 X5 X2 X1 VAR-CW	9.970 to 10.030 V 4.985 to 5.015 V 1.994 to 2.006 V 0.997 to 1.003 V greater than 10 V
1	X1 M	3	1.000 V*	X10 X5 X2 X1 VAR-CW	9.00 to 11.00 V* 4.50 to 5.50 V* 1.80 to 2.20 V* 0.90 to 1.10 V* greater than 10 V

* read on 331A Voltmeter
NOTE: At 10 kHz and 400 Hz, allow for possible error of 3445A of up to ±0.1%.

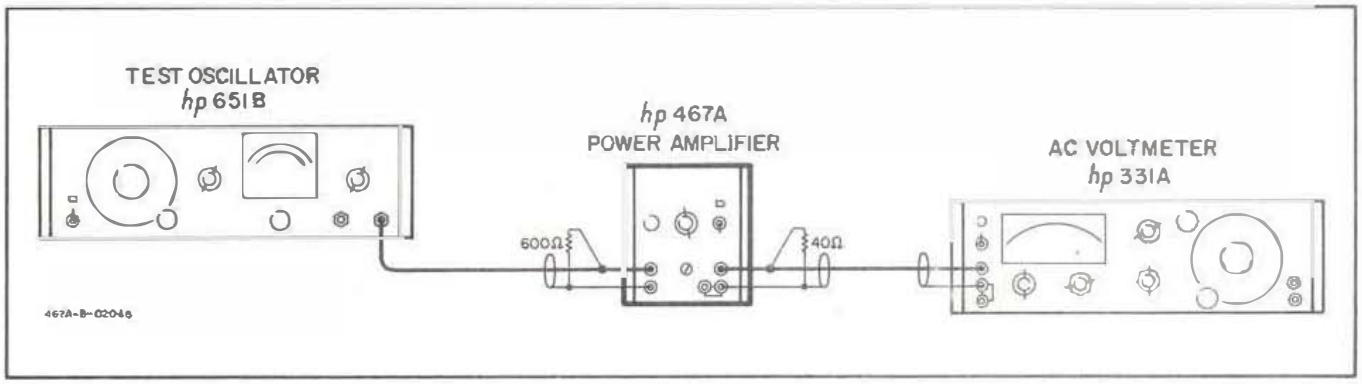


Figure 5-2. Output Capabillty Check

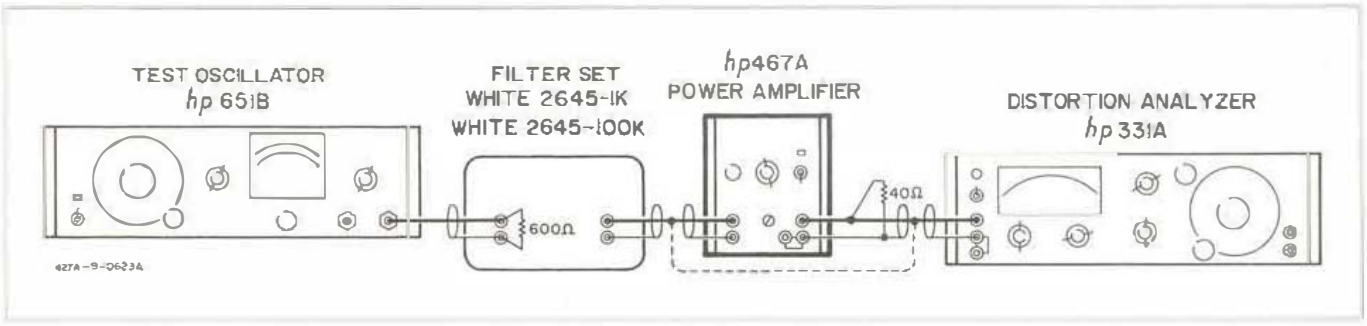


Figure 5-3A. Distortion Check

Lab Model2645 - 1 KHz), a 100 KHz Bandpass Filter (White Instrument Lab Model2645-100 KHz), 40 and 600 ohm load resistors, and the resistors and capacitors listed in Table 5-3 will be required for this test.

Table 5-3, Parts for Figure 5-3B

Designator	-hp- Part No.	Description
R1	0690-8231	R: fxd 82,000 Ω 1 W
R2	0692-5125	R: fxd 5100 Ω 2 W
R3	2100-0006	R: var 5000 Ω 2 W
C1	0121-0021	C: var 5.5 pF to 64.3 pF
C2, C3	0160-0439	C: fxd 22 pF
C4, C5	0160-0474	C: fxd 390 pF
L1	9140-0007	Inductor: var 60-100 μH

b. Connect the 1 KHz filter input to the output of the 651B, Test Oscillator, using a 600 ohm load. Connect the 331A Distortion Analyzer directly to the Filter output as shown in Figure 5-3A Alternate connection.

c. Set the oscillator frequency to 1 KHz. Adjust the output amplitude for the 1.0 volt output.

d. Set the Distortion Analyzer Frequency to 1 KHz; FUNCTION to SET LEVEL; SENSITIVITY to provide upscale deflection. Adjust VERNIER for full scale reading of 1 (100%).

e. Rotate FUNCTION switch to DISTORTION. Null out fundamental signal by alternately reducing the meter range and adjusting BALANCE and frequency control knob for a null. Record the amount of distortion.

f. Disconnect the filter output from the 331A. Connect the filter output to the 467A input. Connect the 467A output to the 331A input across a 40 ohm load, as shown in Figure 5-3A. Set the 467A to X10 position.

g. Set the Distortion Analyzer FUNCTION to SET LEVEL and adjust VERNIER for a full scale reading of 1 (100%).

h. Rotate the FUNCTION switch to DISTORTION and find the null again. The new reading should add less than 0.01% (80 dB down).

i. Repeat steps b through h using the 100 KHz filter and 100 KHz frequency settings on the 651B and the 331A. Distortion added by the 467A at 100 KHz should be less than 1% (40 dB down).

j. For checking distortion at 1 MHz, connect the oscillator across a 600Ω load to the 467A input. Connect the 467A output across a 40 Ω load to the input of a 1 MHz band rejection filter, Fig-

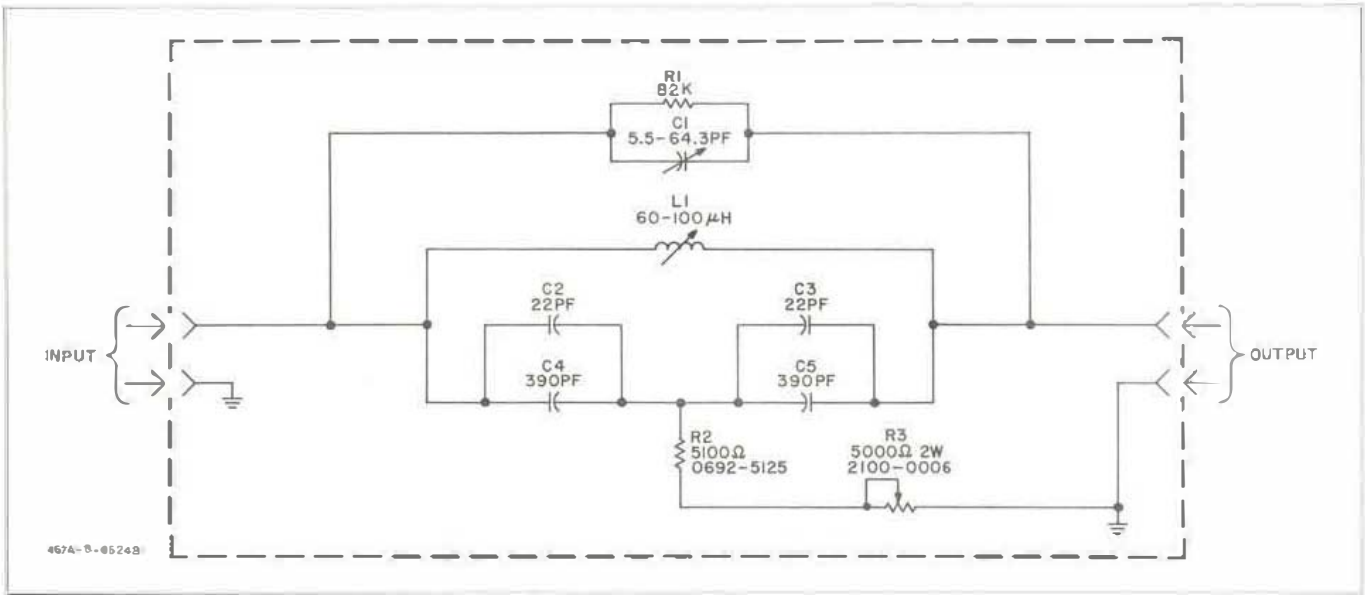


Figure 5-3B. 1 MHz Rejection Filter

ure 5-3B. Set the oscillator frequency to 1 MHz.

k. Adjust the oscillator output for 10 V at the 467A output, using the ac voltmeter. Then connect the ac voltmeter to the filter output and the reading should be less than 0.3 V. The oscillator must have less than 1% distortion for this check.

5-12. DC POWER SUPPLY OPERATION.

5-13. DC VOLTAGE AND CURRENT CHECK.

a. A DC Voltmeter (-hp- Model 3440A/3444A) and a 40 ohm ±5%, 10 watt resistor (-hp- Part No. 0815-0028) will be required.

b. Place the 40 ohm resistor across the Model 467A OUTPUT.

c. Connect the dc voltmeter across the 40 ohm resistor. Set FUNCTION to VOLTS; RANGE to 1000 mV.

d. Set Model 467A to SUPPLY ±1; VOLTS ADJ fully CCW.

e. DC Voltmeter should read greater than -1000 mV.

f. Rotate VOLTS ADJ fully CW. DC Voltmeter should increase from -1.000 to +1.000 V or more.

g. Repeat the above using settings listed in Table 5-4. Dc voltmeter should indicate voltage variations as listed.

h. In the final step, an output current of 0.5 A will be verifled when the ±20 V is obtained across the 40 ohm load resistor.

5-14. LOAD REGULATION CHECK.

a. A DC Voltmeter (-hp- Model 3440A/3444A) and a 2 ohm ±1%, 1/2 watt resistor (-hp- Part No. 0727-0445) will be required for this operation.

b. Connect DC Voltmeter to Model 467A OUTPUT. Set voltmeter FUNCTION to VOLTS; RANGE to 10 V.

c. Set Model 467A to SUPPLY ±1; VOLTS ADJ fully CW.

d. DC Voltmeter should read greater than +1.000 V. Note and record reading.

e. Turn Model 467A LINE to OFF. Connect 2 ohm load resistor across Model 467A OUTPUT. Leave DC Voltmeter connected as in step b.

f. Turn Model 467A LINE ON. DC Voltmeter reading should remain within 10 mV of reading obtained in d above. The load is from 0 to 0.5 A.

5-15. LINE REGULATION CHECK.

a. A DC Voltmeter (-hp- Model 3440A/3444A) and a Variable Voltage Line Transformer (Superior Electric Company, Type UC1M) will be required for this operation.

b. Connect the DC Voltmeter to the Model 467A OUTPUT. Set FUNCTION to VOLTS; RANGE to 10 V.

c. Set Model 467A to SUPPLY ±10; VOLTS ADJ fully CCW. DC Voltmeter should read greater than -10.00. Note and record reading.

d. Connect variable voltage line transformer between Model 467A power plug and line power source.

e. Adjust line transformer for 126.5 V output. DC Voltmeter reading should remain within 10 mV of reading obtained in c above.

f. Reset line transformer for 103.5 V output. DC Voltmeter reading should remain within 10 mV of reading obtained in c above.

5-16. OUTPUT IMPEDANCE CHECK.

a. Figure 5-4 describes the test arrangement recommended. An AC Voltmeter (-hp- Model 331A), a Test Oscillator (-hp- Model 651B), and a 12 ohm ± 1%, 1/2 watt resistor (-hp- Part No. 0811-0297) will be required.

b. Connect the Model 467A as shown in Figure 5-4.

c. Short Model 467A front panel INPUT; set to AMPLIFIER X10.

d. Adjust oscillator for 1.0 V rms, 500 KHz output. Verify output using AC Voltmeter.

e. Voltage across 12 ohm resistor should be 0.8 V or greater. At 500 KHz, Model 467A output impedance is 3 ohms or less where $E_{OSC} = E_{12\ ohms} + E_{467}$.

5-17. CAPACITIVE LOAD CHECK.

a. An Oscilloscope (-hp- Model 175A) and 0.01 μF ± 10%, 200 V capacitor (-hp- Part No. 0160-0304) will be required for this test.

b. Set Model 467A to SUPPLY ±20; VOLTS ADJ fully CW.

Table 5-4. DC Power Supply Operation

Model 467A		Model 3440A/3444A DC Voltmeter		
Supply	Volts Adj Rotate from Fully	Range	Function	Reading (minimum designated)
1	CCW to CW	1000 mV	VOLTS	- 1.000 to + 1.000 V
2	CW to CCW	10 V	VOLTS	+ 2.000 to - 2.000 V
4	CCW to CW	10 V	VOLTS	- 4.000 to + 4.000 V
10	CW to CCW	10 V	VOLTS	+10.00 to -10.00 V
20	CCW to CW	100 V	VOLTS	-20.00 to +20.00 V

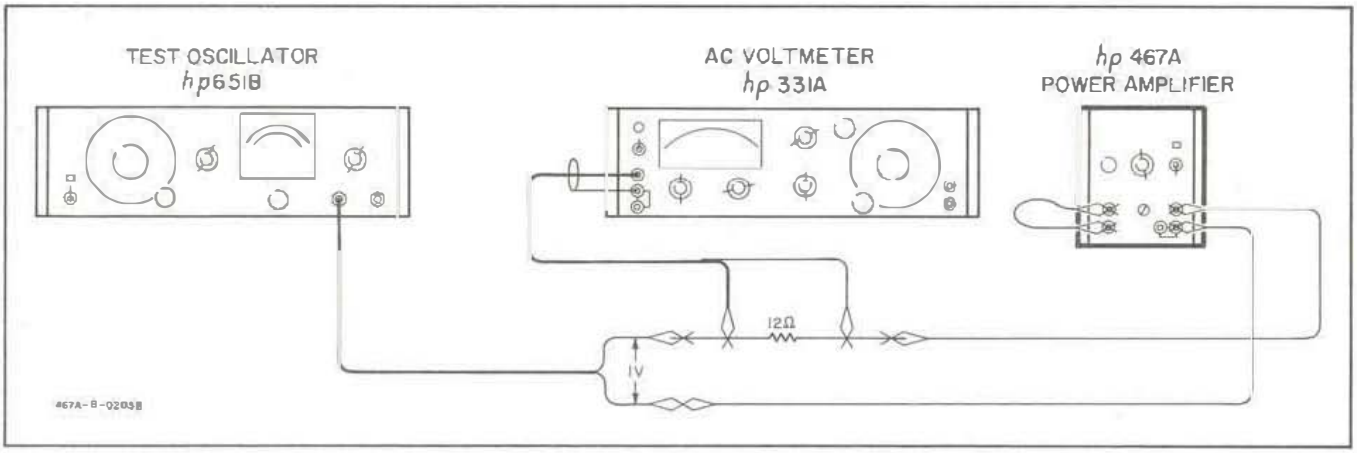


Figure 5-4. Output Impedance Check

c. Connect capacitor and oscilloscope to Model 467A OUTPUT. Output waveform should be stable (no oscillations or ringing present).

5-18. RIPPLE AND NOISE CHECK.

a. An AC Voltmeter (-hp- Model 331A) will be required for this operation. Connect AC Voltmeter to Model 467A output. Set RANGE to 0.003 V.

b. Set Model 467A to SUPPLY ±20; VOLTS ADJ fully CW (+20.00 V). Short Model 467A INPUT.

c. AC Voltmeter should read less than 1.77 mV rms (5 mV peak-to-peak).

d. Rotate AMPLIFIER/SUPPLY switch to AMPLIFIER X10.

e. AC Voltmeter should still read less than 1.77 mV rms (5 mV peak-to-peak).

5-19. CURRENT LIMIT CHECK.

a. A DC Milliammeter (-hp- Model 428B) and a DC Voltmeter (-hp- Model 3440A/3444A) will be required. Set the 467A to SUPPLY ±20, and adjust the VOLTS ADJ until an output voltage of 0.000 volts is obtained, using the dc voltmeter.

b. Short the 467A output and connect the 428B, set on the 1 A range, as shown in Figure 5-5. As the VOLTS ADJ is varied slowly, the 428B should show an increasing current that is always less than 800 mA.

5-20. POWER SUPPLY VOLTAGE CHECKS.

a. A DC Voltmeter (-hp- Model 3440A/3444A) will be required for this check.

b. Connect DC Voltmeter between point designated in Table 5-5 and circuit ground. Voltmeter should display readings as indicated.

Table 5-5. Power Supply Voltage Checks

Connect DC Voltmeter Between Circuit Ground and	DC Voltmeter Readings
J2, Pin 7	-32.5 to -35.7 V
J2, Pin 2	+32.2 to +36.0 V
J1, Pin 3	+ 7 V
J1, Pin 4	- 7 V
Cathode of CR146	+15 V
Anode of CR123	-15 V
+ side of C111	+50 V
J2, Pin 1	-50 V

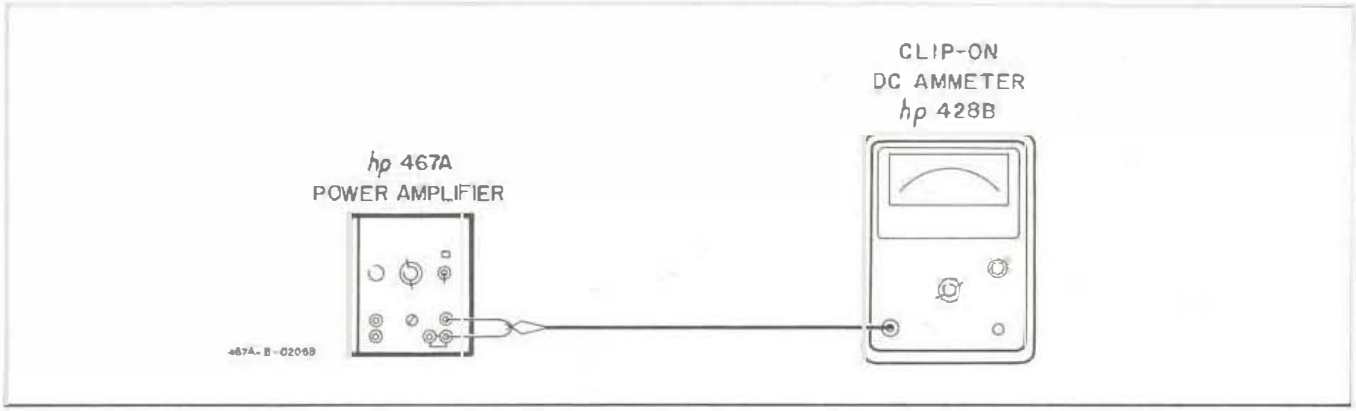


Figure 5-5. Current Limit Check

5-21. ADJUSTMENT AND CALIBRATION PROCEDURES.

5-22. The following is a complete adjustment and calibration procedure for the Model 467A. These operations should be conducted only if it has previously been established by Performance Checks, Paragraph 5-5, that the Model 467A is out of adjustment. Indiscriminate adjustment of the instrument controls to "refine" readings may actually cause more difficulty. If the procedures outlined below do not rectify any discrepancies that may exist, and all connections and settings have been rechecked, refer to Paragraph 5-31, Troubleshooting Techniques, for possible cause and recommended corrective action.

5-23. ZERO ADJUST.

a. A DC Voltmeter (-hp- Model 3440A/3444A) will be required for this operation.

b. Connect dc voltmeter to Model 467A OUTPUT. Set FUNCTION to VOLTS; RANGE to 100 mV.

c. Set Model 467A to AMPLIFIER X10. Short INPUT.

d. Adjust R5 (front panel ZERO) for zero reading on DC Voltmeter.

e. Remove short at Model 467A INPUT.

f. Adjust R133 (internal adjustment) for zero reading on DC Voltmeter.

g. If necessary, repeat steps d through f above until voltage difference is less than 1.0 mV.

5-24. CURRENT LIMIT ADJUSTMENT.

5-25. -34 V ADJUST (R159).

a. A DC Voltmeter (-hp- Model 3440A/3444A) and a DC Milliammeter (-hp- Model 428B) will be required for this test.

b. Connect DC Voltmeter to Model 467A OUTPUT. Set DC Voltmeter FUNCTION to VOLTS; RANGE to 100 V.

c. Set Model 467A to SUPPLY ±20; VOLTS ADJ fully CCW.

d. DC Voltmeter should read -20.00 V.

e. Short Model 467A output. Connect dc milliammeter as shown in Figure 5-5. Set dc milliammeter RANGE to 1 A.

f. Adjust R159 for ammeter reading of 650 mA.

5-26. +34 V ADJUST (R163).

a. Rotate VOLTS ADJ fully CW (+20.00V output).

b. Adjust R163 for ammeter reading of 650 mA.

5-27. DC GAIN ADJUSTMENT (R147).

a. A DC Standard (-hp- Model 741B) and a DC Voltmeter (-hp- Model 3440A/3444A) will be required for this operation.

b. Set Model 467A to AMPLIFIER X10.

c. Connect dc voltmeter to Model 467A OUTPUT. Set FUNCTION to VOLTS; RANGE to 10 V.

d. Adjust DC Standard for +1 V dc output. Apply to Model 467A INPUT.

e. DC Voltmeter should read 10.0 V. If not, adjust R147 for proper reading.

5-28. BALANCE ADJUST (C124).

a. Figure 5-6 describes the test arrangement recommended. A Test Oscillator (-hp- Model 651B), a DC Voltmeter (-hp- Model 3440A/3444A), an AC Voltmeter (-hp- Model 331A) and a 40 ohm ±5%, 10 watt resistor (-hp- Part No. 0815-0028) will be required.

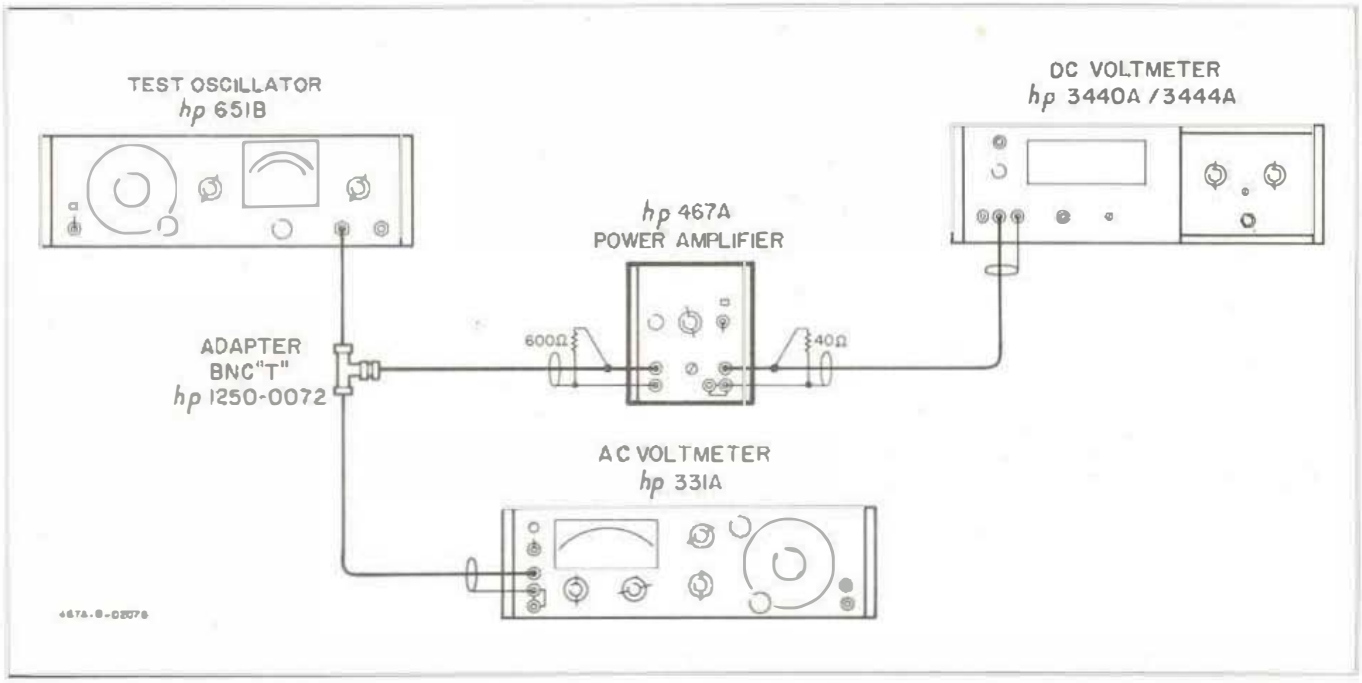


Figure 5-6. Balance Adjust

b. Connect Model 467A as shown in Figure 5-6.

c. Set DC Voltmeter FUNCTION to VOLTS; RANGE to 1000 mV.

d. Set Model 467A to AMPLIFIER X10.

e. Adjust oscillator for 1.4 V rms, 300 KHz output. (Use AC Voltmeter to verify 1.4 V rms signal level.)

f. Tune C124 to minimum dc output as read on DC Voltmeter.

5-29. HIGH FREQUENCY COMPENSATION ADJUSTMENT (C301, C303, C305).

a. Figure 5-7 describes the test arrangement recommended. A Test Oscillator (-hp- Model 651B), 600 and 40 ohm loads and an AC Voltmeter (-hp- Model 331A) will be required.

b. Connect Model 467A as shown in Figure 5-7. Set Model 467A to AMPLIFIER X10.

c. Set the Test Oscillator (651B) frequency to 1 MHz. Adjust AMPLITUDE and OUTPUT ATTENUATOR for AC Voltmeter reading of 1.0 V.

d. Set Model 467A to AMPLIFIER X5. Tune C305 for an AC Voltmeter reading between 0.498 and 0.502.

e. Set Model 467A to AMPLIFIER X2. Tune C303 for an AC Voltmeter reading between 0.198 and 0.202.

f. Set Model 467A to AMPLIFIER X1. Tune C301 for AC Voltmeter reading between 0.098 and 0.102.

5-30. AC GAIN ADJUSTMENT (R148).

a. Test Oscillator (-hp- Model 651B), AC Voltmeters (-hp- 331A and 3440A/3445A), and 40 and 600 ohm loads will be required.

b. Connect test equipment as shown in Figure 5-1.

c. Set the Oscillator frequency to 100 KHz; and with the AC Voltmeter connected to the INPUT of the 467A (as A in Figure 5-1), adjust the output of the Oscillator for 1 volt as read on the AC Voltmeter.

d. Connect the AC Voltmeter to the OUTPUT of the 467A. Set 467A to AMPLIFIER X10.

e. Adjust R148 for a 10 volt reading on the AC Voltmeter.

f. Repeat ac accuracy and gain check, Paragraph 5-9. (AC Voltmeter readings should be between the limits listed in the last column of Table 5-2.)

5-31. TROUBLESHOOTING TECHNIQUES.

5-32. This section contains procedures designed to assist in the isolation of malfunctions. These procedures are based on a systematic analysis of the instrument circuitry. These operations should be undertaken only after it has been established that the difficulty cannot be eliminated by the Adjustment and Calibration Procedures, Paragraph 5-21. An investigation should also be made to insure that the trouble is not a result of conditions external to the Model 467A.

5-33. Conduct a visual check of the Model 467A for possible burned or loose components, loose connections, or any other obvious conditions which suggest a source of trouble.

5-34. Table 5-6 contains a summary of the front-panel symptoms that may be encountered. It should be used in initial efforts to select a starting point for troubleshooting operations.

5-35. Table 5-7, in conjunction with Figure 5-8, contains procedures which may be used as a guide in isolating malfunctions. The steps in Table 5-7 describe the normal conditions which should be encountered during the checks (circled numbers (N)) in Figure 5-8.

5-36. The checks outlined in Table 5-7 are not designed to measure all circuit parameters, rather only to localize the malfunction. Therefore, it is quite possible that additional measurements may be required to completely isolate the problem. Amplifier gain may also vary slightly between instruments; therefore, it should not be necessary to precisely duplicate voltage values described.

5-37. Conditions described in Figure 5-8 and Table 5-7 are based on the Model 467A set to SUPPLY ±20; and VOLTS ADJ set fully clockwise. Under normal operating conditions, this would provide an output voltage of +20 to +22 Vdc.

5-38. SERVICING ETCHED CIRCUIT BOARDS.

5-39. The -hp- Model 467A has three etched circuit boards. Use caution when removing them to avoid

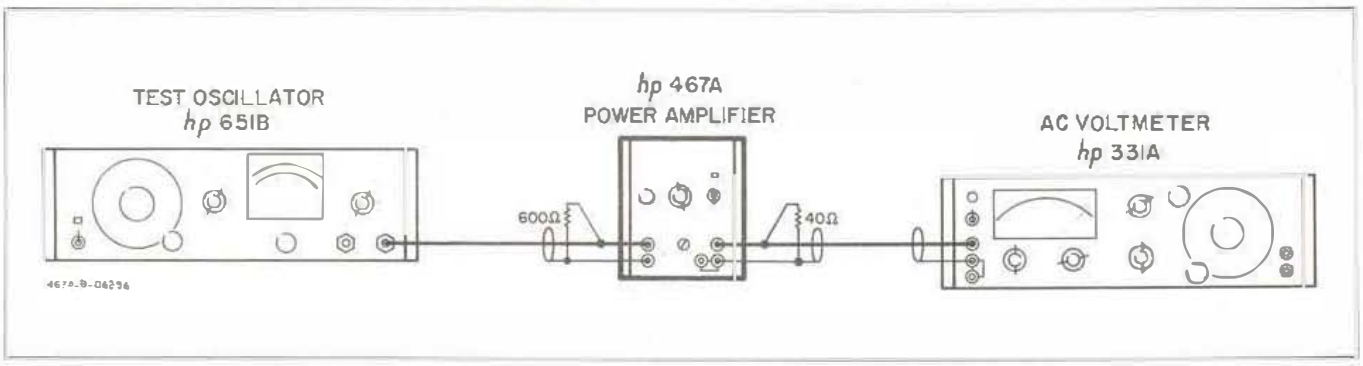


Figure 5-7. High Frequency Compensation Adjustment

Table 5-6. Troubleshooting - Front Panel Symptoms

FRONT PANEL SYMPTOMS	POSSIBLE CAUSE
Line lamp not glowing. Power ON.	Check fuse F1.
Functions properly as power supply but not as amplifier.	Check QI01.
Functions properly as amplifier, but not as power supply.	Check QI08, Q109 and Q110.
Functions properly as amplifier in all ranges except:	
X1	Check R301, C301, C302 and C202.
X2	Check R302, C303, C309 and C203.
X5	Check R303, C305, C306 and C307.
Functions properly as power supply in all ranges except ±1.	Check R201.
Functions properly as power supply in all ranges except ±1 and ±2.	Check R207.
Functions properly as power supply in all ranges except ±1, ±2 and ±4.	Check R207 and R208.
Functions properly as power supply only in ±20 range.	Check R206 thru R209.
Power supply output is -24 V regardless of SUPPLY or VOLTS ADJ setting.	Check for shorted C115.

damaging mounted components. The assembly -hp- part number is silk screened on the exterior of the circuit board to identify it. Refer to Section VI for parts replacement and -hp- part number information.

5-40. The etched circuit boards are a plated-through type. The electrical connection between sides of the board is made by a layer of metal plated through the component holes. When working on these boards, observe the following general rules.

a. Use a low-heat (25 to 50 watt) small-tip soldering iron, and a small diameter rosin core solder.

b. Circuit components can be removed by placing the soldering iron on the component lead on either side of the boards, and pulling up on lead. If a component is obviously damaged, clip leads as close to component as possible and then remove. Excess heat can cause the circuit and board to separate, or cause damage to the component.

c. Component lead hole should be cleaned before inserting new lead.

d. To replace components, shape new leads and insert them in holes. Reheat with iron and addsolder as required to insure a good electrical connection.

e. Clean excess flux from the connection and adjoining area.

f. To avoid surface contamination of the printed circuit, clean with weak solution of warm water and mild detergent after repair. Rinse thoroughly with clean water. When completely dry, spray lightly with Krylon (#1302 or equivalent).

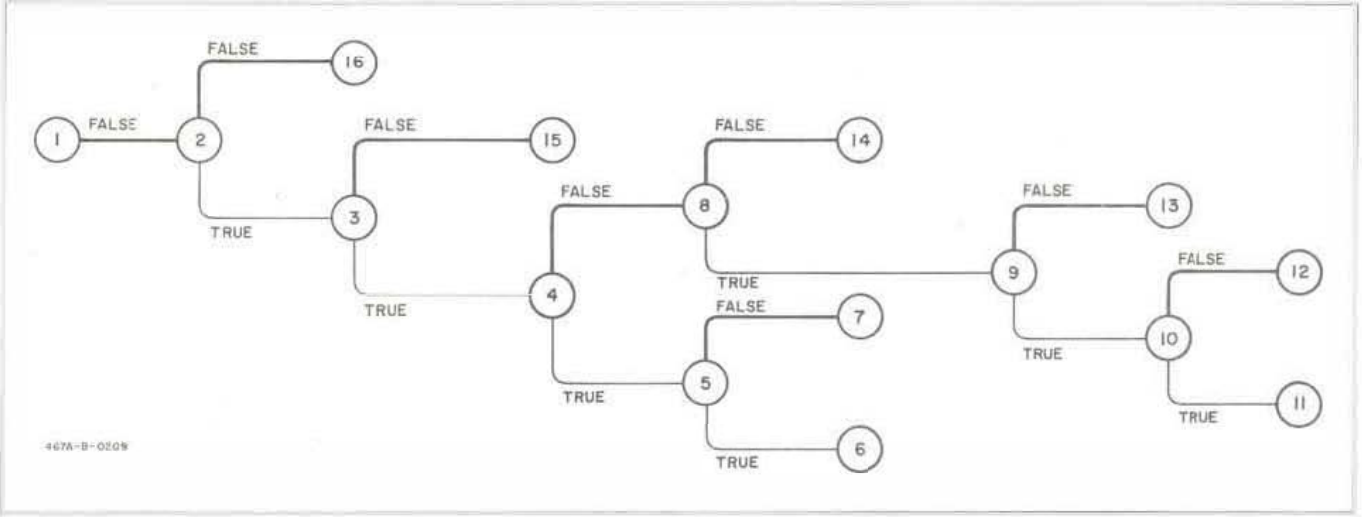


Figure 5-8. Troubleshooting Tree

Table 5-7. Power Supply Checks

Conditions: SUPPLY ±20; VOLTS ADJ fully CW.

(1) Measure dc output voltage. Should be approximately +20.00 V dc. If not, proceed to (2).

(2) Measure dc power supply voltages as outlined in Paragraph 5-20. If they are correct, proceed to (3); if not, go directly to (16).

(3) Measure dc voltages at + side C101. Should be approximately +2.0 V dc. If so, proceed to (4); if not, go directly to (16).

(4) Measuredc voltage at base of Q103. Voltage should be +4.6 V dc. If not, break the circuit at the base of Q103, insert enough dc voltage through a 1K resistor to obtain the proper signal level at the base of Q103. Recheck instrument dc output voltage. If it is now +20.00 V, proceed to (5); if not, go directly to (8).

(5) Measure dc voltage at base of Q109. Should be approximately +2.2 V dc. If correct, proceed to (6); if not, go directly to (7).

(6) Check Q108, Q109, Q110, R133, C109, C115, C122 and other closely associated components.

(7) Check R6, R147, R144, C124, R142, R143, and R5.

(8) Measure dc voltage at base of Q105. Should be approximately +31 V dc. If so, proceed to (9); if not, go directly to (14).

(9) Measure dc voltage at J1, Pin 15. Should be approximately -34 V dc. If so, proceed to (10); if not, go directly to (13).

(10) Measure dc voltage at J1, Pin 11. Should be approximately +23 V dc. If so, proceed to (11); if not, go directly to (12).

(11) Check Q1, Q2, Q3 and Q4 (remove instrument bottom cover).

(12) Check Q105, Q106, R136, R122 and CR107.

(13) Check Q107, R123, and CR108 - 114.

(14) Check Q102, Q103, Q104 and closely associated components.

(15) Check switch circuit to include R206 - 209, R202 - 205, R4 and C1 for short.

(16) If -34 V supply is zero, check Q7, Q8, R163 and surrounding components. If -34 v is less than -30 V (but not zero), check Q3, Q4, Q105, CR108 - 114 and Q107 for short.

If +34 V supply is zero, check Q5, Q6, R159 and surrounding components. If this does not reveal malfunction, check Q1, Q2, Q105 and Q106 for short.

If +7 V supply is incorrect, check CR115, CR116, and C125.

If -7 V supply is incorrect, check CR117, CR118, and C127.

If +15 V is incorrect, check circuit from base of Q109 to CR146.

If -15 V is incorrect, check circuit from base of Q109 to CR123.

If +50 V is incorrect, check C111, CR125-128 and T1 output (J2, Pins 8 - 10).

If -50 V is incorrect, check C2, CR125 - 128 and T1 output (J2, Pins 8 - 10).

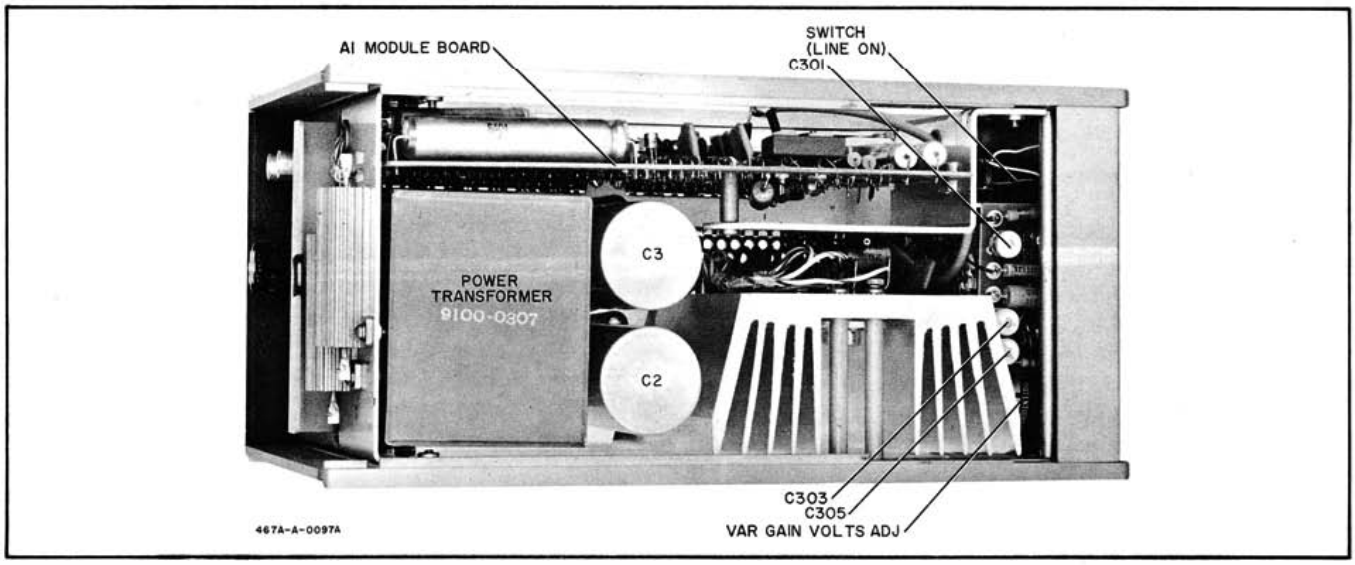


Figure 5-9. Top View

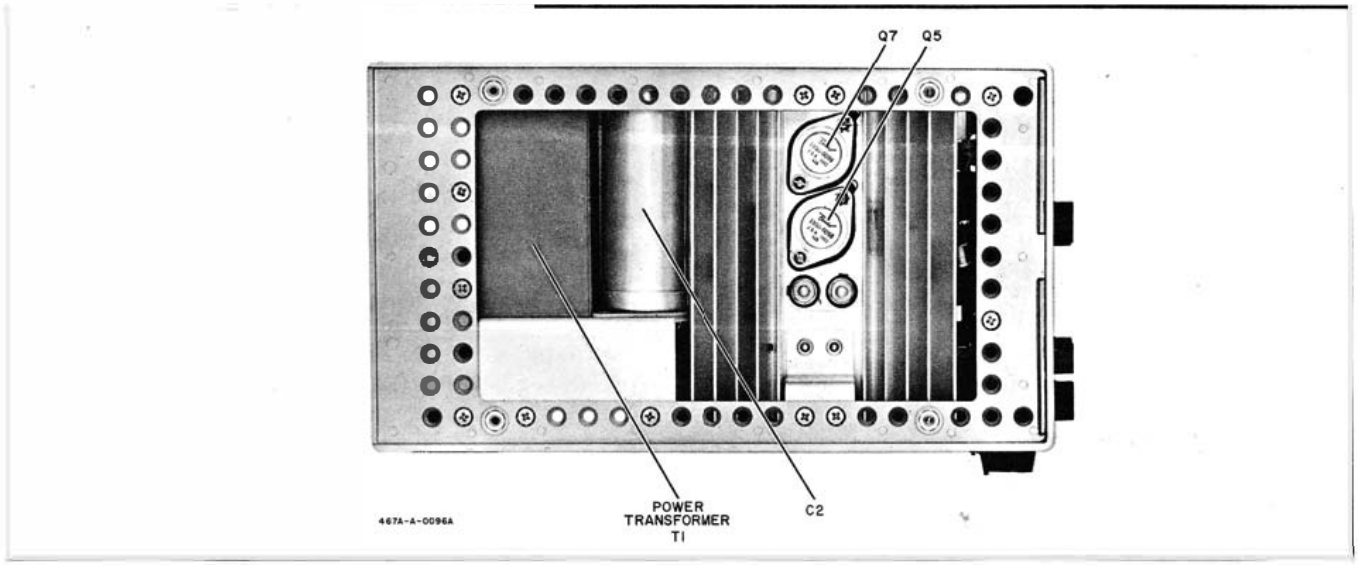


Figure 5-10. Side View

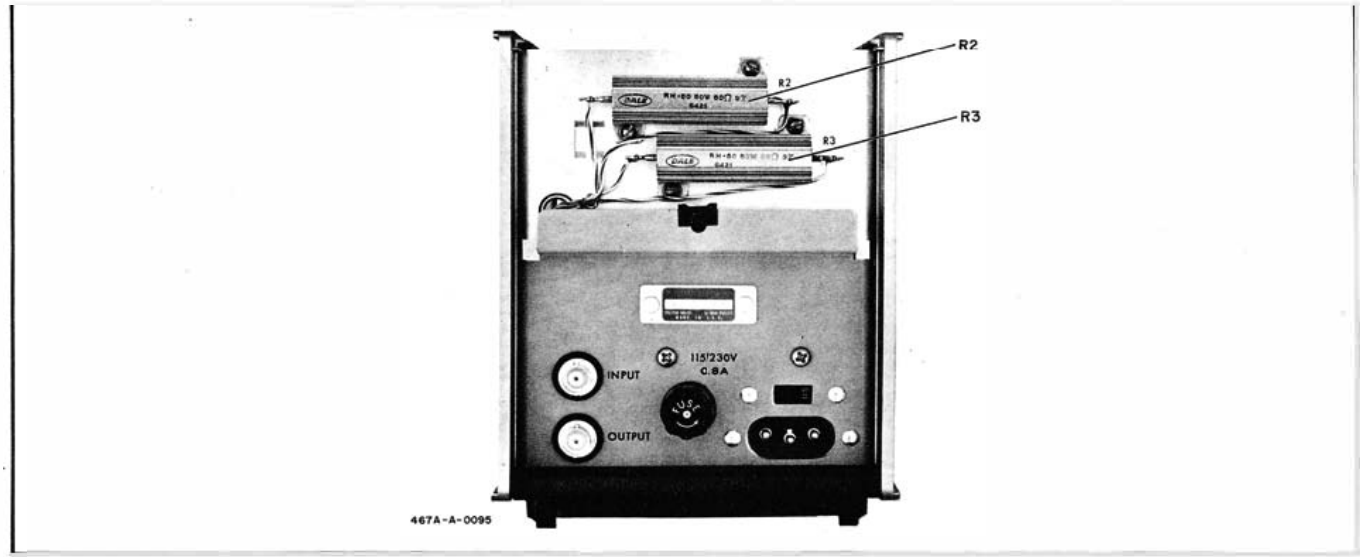
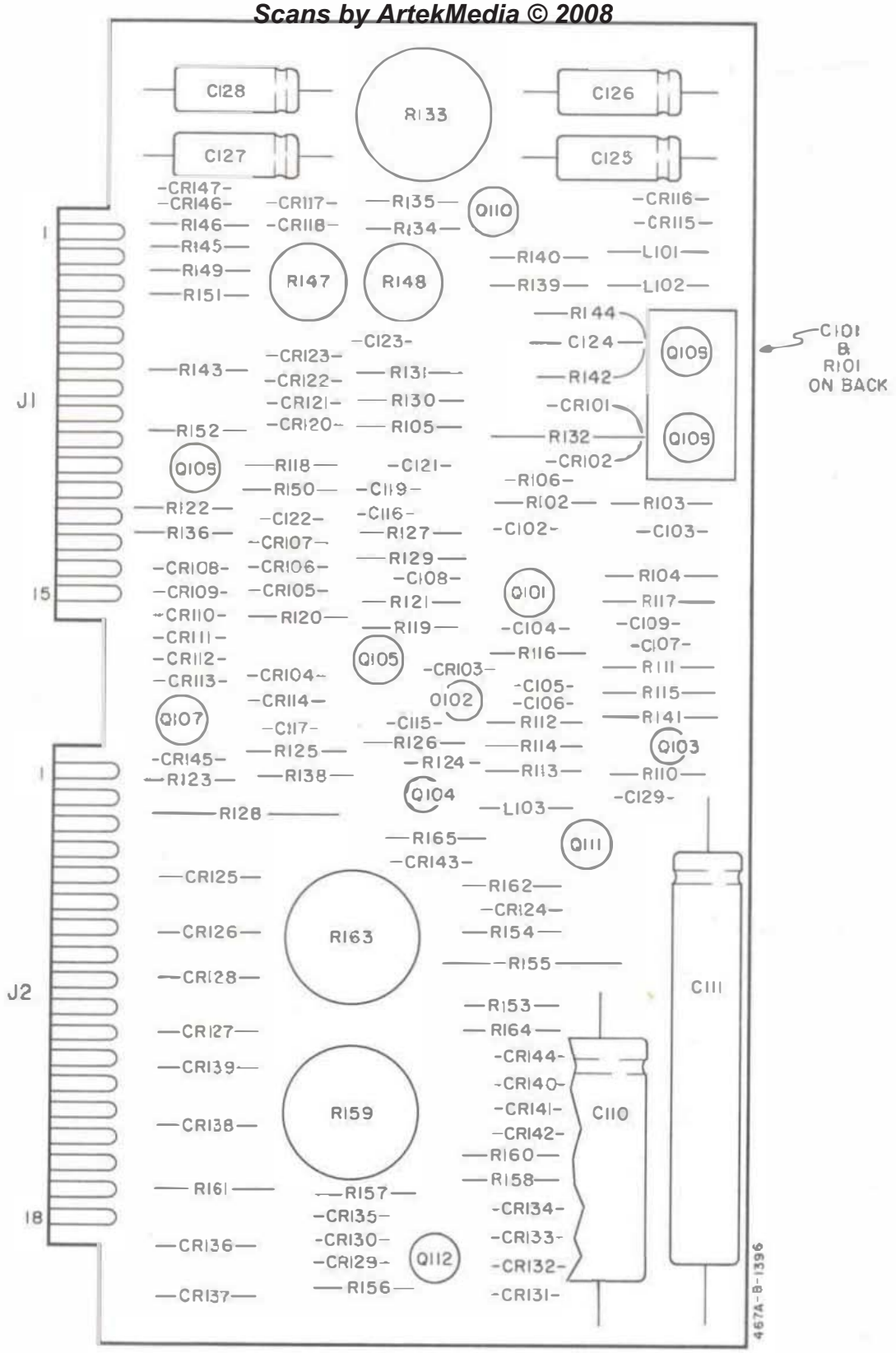


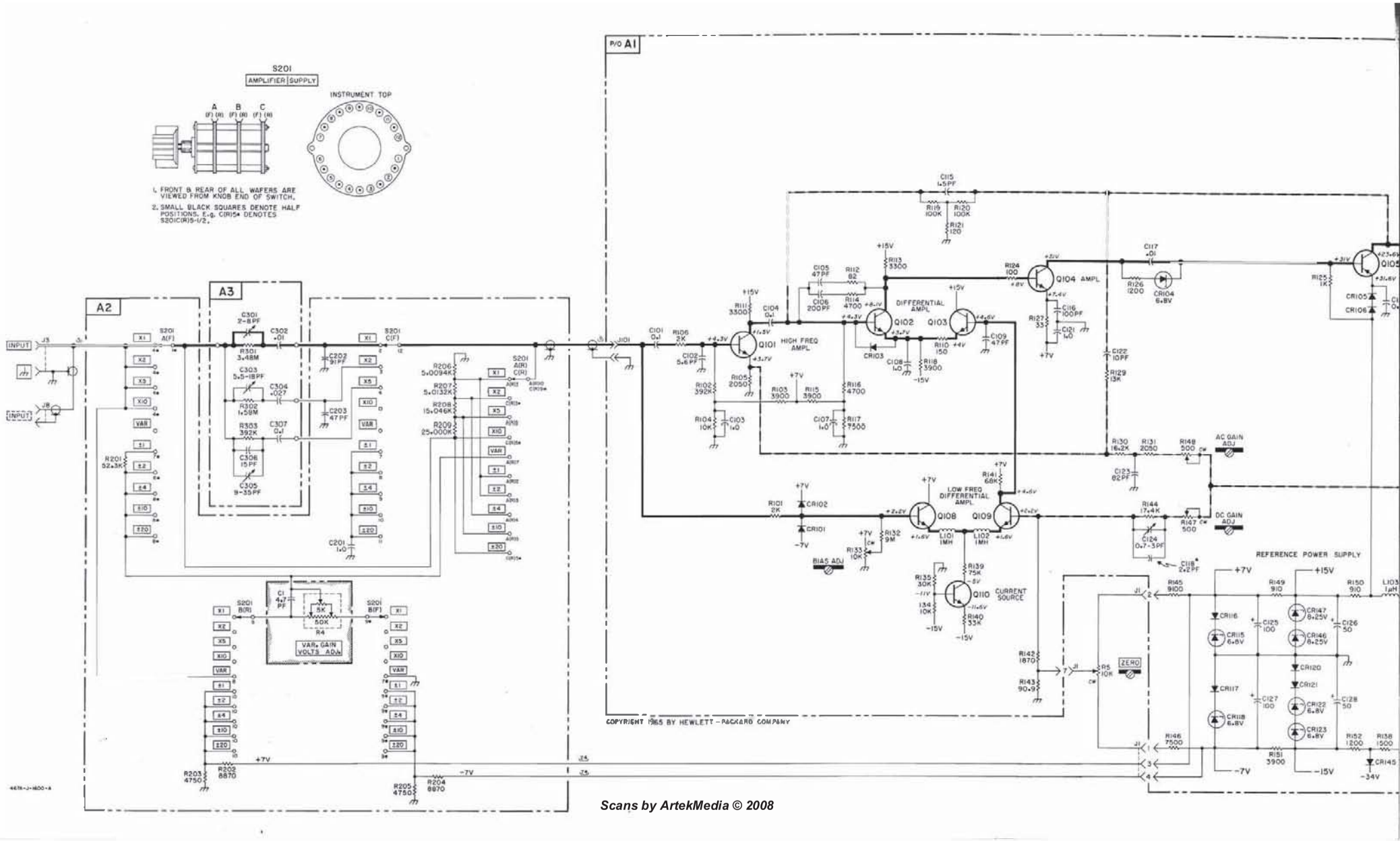
Figure 5-11. Rear Panel

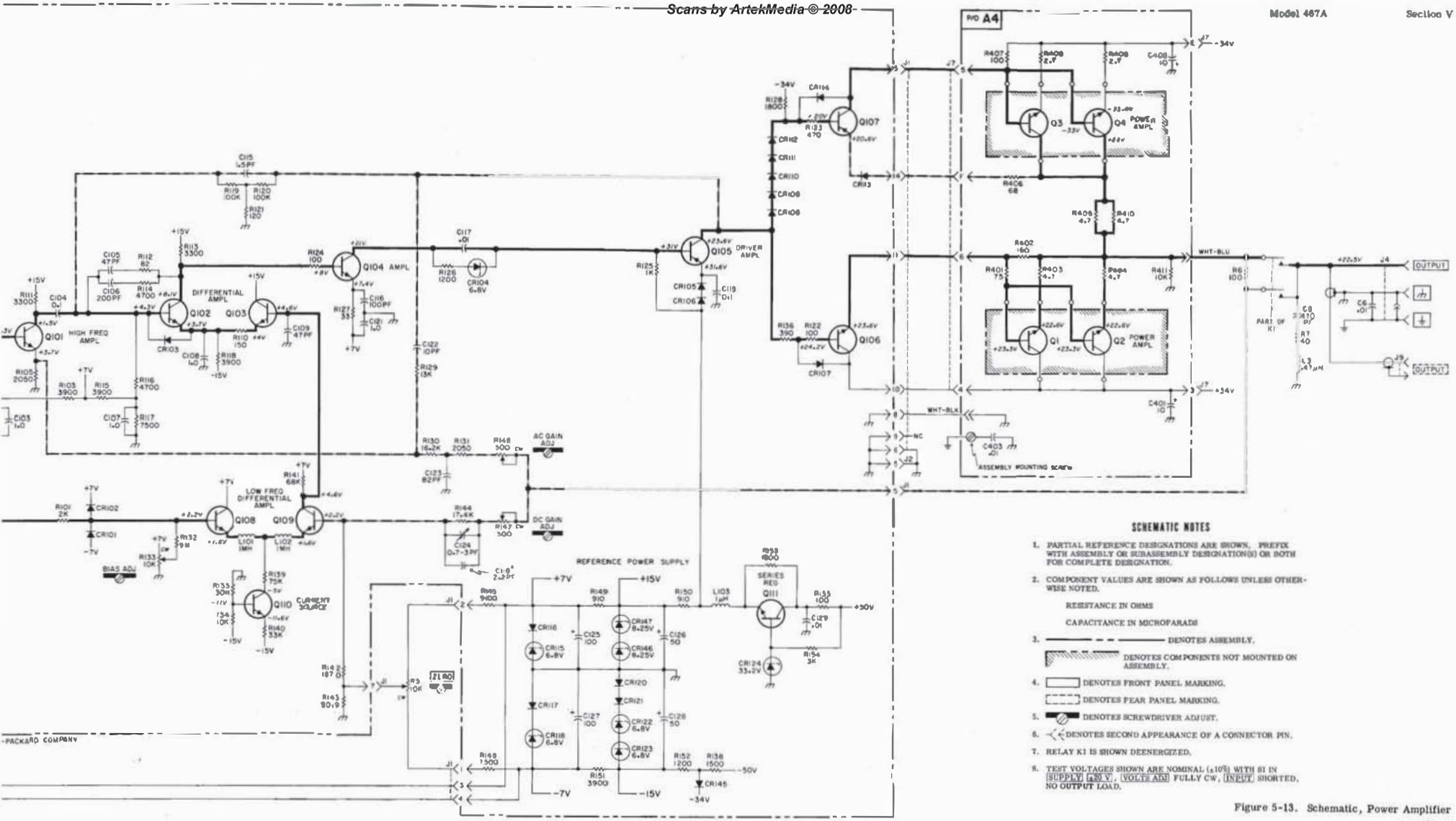


A1

hp Part No. 00467-66501

Figure 5-12. Printed Circuit Board (A1), Parts Location





SCHEMATIC NOTES

1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. PREFIX WITH ASSEMBLY OR SUBASSEMBLY DESIGNATION(S) OR BOTH FOR COMPLETE DESIGNATION.
2. COMPONENT VALUES ARE SHOWN AS FOLLOWS UNLESS OTHERWISE NOTED.

   RESISTANCE IN OHMS

   CAPACITANCE IN MICROFARADS
3. ——— DENOTES ASSEMBLY.

   DENOTES COMPONENTS NOT MOUNTED ON ASSEMBLY.
4. DENOTES FRONT PANEL MARKING.

   DENOTES REAR PANEL MARKING.
5. DENOTES SCREWDRIVER ADJUST.
6. DENOTES SECOND APPEARANCE OF A CONNECTOR PIN.
7. RELAY K1 IS SHOWN DEENERGIZED.
8. TEST VOLTAGES SHOWN ARE NOMINAL (±10%) WITH S1 IN SUPPLY ±20 V, VOLTS ADJ FULLY CW, INPUT SHORTED, NO OUTPUT LOAD.

Figure 5-13. Schematic, Power Amplifier

5-11/5-12

SCHEMATIC NOTES

1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. PREFIX WITH ASSEMBLY OR SUBASSEMBLY DESIGNATION(S) OR BOTH FOR COMPLETE DESIGNATION.

2. COMPONENT VALUES ARE SHOWN AS FOLLOWS UNLESS OTHERWISE NOTED.

   RESISTANCE IN OHMS

   CAPACITANCE IN MICROFARADS

3. ——————— DENOTES MAIN SIGNAL PATH.

   — — — — — — — — DENOTES FEEDBACK PATH.

4. ——— — — ——— DENOTES ASSEMBLY.

   DENOTES COMPONENTS NOT MOUNTED ON ASSEMBLY.

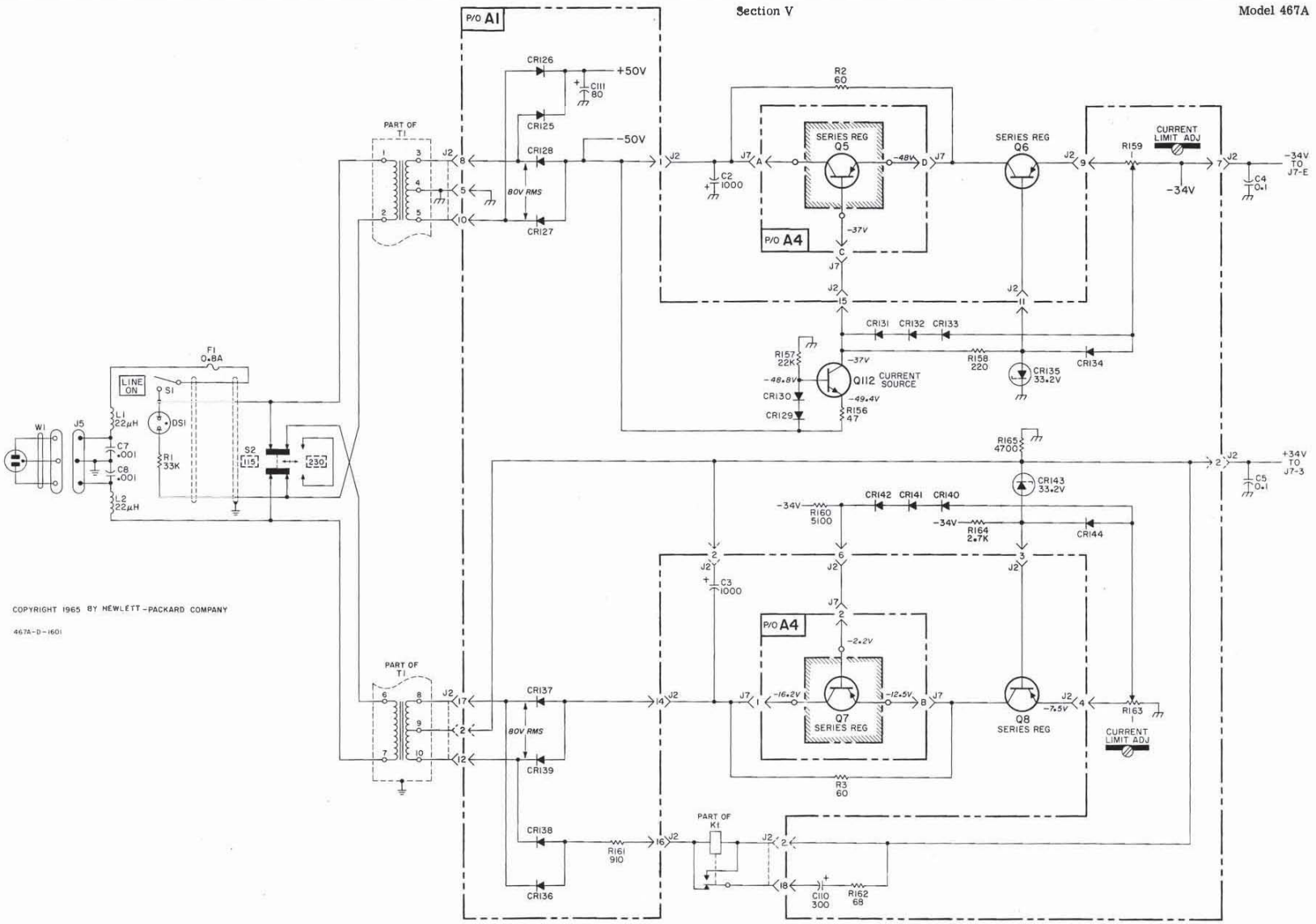
5. [ ] DENOTES FRONT PANEL MARKING.

   [ ] DENOTES REAR PANEL MARKING.

6. DENOTES SCREWDRIVER ADJUST.

7. RELAY K1 IS SHOWN DEENERGIZED.

8. TEST VOLTAGES SHOWN ARE NOMINAL (±10%) WITH S1 IN [SUPPLY] [±20 V], [VOLTS ADJ] FULLY CW, [INPUT] SHORTED, NO OUTPUT LOAD.



467A-D-1601

Figure 5-14. Schematic, Power Supply

PERFORMANCE CHECK TEST CARD

Hewlett-Packard Model 467A
Power Amplifier/Supply
Serial No. _____

Test Performed by _____
Date _____

DESCRIPTION	CHECK	
1. DC Gain Check	TEST LIMITS	INDICATION
X10	9.97 V to 10.03 V	_____
X5	4.985 V to 5.015 V	_____
X2	1.994 V to 2.006 V	_____
X1	0.997 V to 1.003 V	_____
VAR.	0 V to 10 V	_____
2. AC Accuracy and Gain Check	TEST LIMITS	INDICATION
100 kHz		
X10	9.900 V to 10.100 V	_____
X5	4.950 V to 5.050 V	_____
X2	1.980 V to 2.020 V	_____
X1	0.990 V to 1.010 V	_____
VAR-CW	greater than 10 V	_____
10 kHz		
X10	9.970 to 10.030 V	_____
X5	4.985 to 5.015 V	_____
X2	1.994 to 2.006 V	_____
X1	0.997 to 1.003 V	_____
VAR-CW	greater than 10 V	_____
400 Hz		
X10	9.970 to 10.030 V	_____
X5	4.985 to 5.015 V	_____
X2	1.994 to 2.006 V	_____
X1	0.997 to 1.003 V	_____
VAR-CW	greater than 10 V	_____
1 MHz		
X10	9.00 V to 11.00 V	_____
X5	4.50 V to 5.50 V	_____
X2	1.80 V to 2.20 V	_____
X1	0.90 V to 1.10 V	_____
VAR-CW	greater than 10 V	_____
3. Distortion Check	SPECIFICATION	INDICATION
1 kHz	add < 0.01% (80 dB down)	_____
100 kHz	add < 1% (40 dB down)	_____
1 MHz	less than 0.3 V	_____
4. DC Voltage and Current Check	SPECIFICATION	INDICATION
1 V CCW	> - 1.000 V	_____
1 V CW	> + 1.000 V	_____
2 V CW	> + 2.000 V	_____
2 V CCW	> - 2.000 V	_____
5 V CCW	> - 5.000 V	_____
5 V CW	> + 5.000 V	_____
10 V CW	> +10.00 V	_____
10 V CCW	> -10.00 V	_____
20 V CCW	> -20.00 V	_____
20 V CW	> +20.00 V	_____
5. Load Regulation Check	SPECIFICATION	INDICATION
No load	> +1.000 V	_____
2 Ω load	within 10 mV of no load	_____

PERFORMANCE CHECK TEST CARD (CONT'D)

DESCRIPTION	CHECK	
6. Line Regulation Check	SPECIFICATION	INDICATION
115 V line	>-1.000 V	_____
126.5 V line	within 10 mV of 115 V line	_____
103.5 V line	within 10 mV of 115 V line	_____
7. Output Impedance Check	SPECIFICATION	INDICATION
500 kHz	>0.8 V	_____
8. Capacitive Load Check	SPECIFICATION	INDICATION
Oscilloscope pattern	no oscillations	_____
9. Ripple and Noise Check	SPECIFICATION	INDICATION
Supply Check	<1.77 mV rms	_____
Amplifier Check	<1.77 mV rms	_____
10. Current Limit Check	SPECIFICATION	INDICATION
Shorted output	<800 mA	_____

SECTION VI
REPLACEABLE PARTS

6-1. INTRODUCTION.

6-2. This section contains information for ordering replacement parts. Table 6-1 lists parts in alphameric order of their reference designators and indicates the description, -hp- part number of each part, together with any applicable notes, and provides the following:

a. Total quantity used in the instrument (TQ column). The total quantity of a part is given the first time the part number appears.

b. Description of the part. (See list of abbreviations below.)

c. Typical manufacturer of the part in a five-digit code. (See Appendix A for list of manufacturers.)

d. Manufacturer's part number.

6-3. Miscellaneous parts are listed at the end of Table 6-1.

6-4. ORDERING INFORMATION.

6-5. To obtain replacement parts, address order or inquiry to your local Hewlett-Packard Field Office. (See Appendix B for list of office locations.) Identify parts by their Hewlett-Packard part numbers. Include instrument model and serial numbers.

6-6. NON-LISTED PARTS.

6-7. To obtain a part that is not listed, include:

a. Instrument model number.

b. Instrument serial number.

c. Description of the part.

d. Function and location of the part.

DESIGNATORS

A	= assembly	F	= fuse	MP	= mechanical part	TC	= thermocouple
B	= motor	FL	= filter	P	= plug	V	= vacuum tube, neon bulb, photocell, etc.
BT	= battery	HR	= heater	Q	= transistor	W	= cable
C	= capacitor	IC	= integrated circuit	QCR	= transistor-diode	X	= socket
CR	= diode	J	= jack	R	= resistor	XDS	= lampholder
DL	= delay line	K	= relay	RT	= thermistor	XF	= fuseholder
DS	= lamp	L	= inductor	S	= switch	Z	= network
E	= misc electronic part	M	= meter	T	= transformer		

ABBREVIATIONS

Ag	= silver	ID	= inside diameter	ns	= nanosecond (s) = 10^{-9} seconds	sl	= slide
Al	= aluminum	impg	= impregnated			SPDT	= single-pole double-throw
A	= ampere (s)	incd	= incandescent	nsr	= not separately replaceable	SPST	= single-pole single-throw
Au	= gold	ins	= insulation (ed)				
C	= capacitor			Ω	= ohm (s)	Ta	= tantalum
cer	= ceramic	kΩ	= kilohm (s) = 10^{+3} ohms	obd	= order by description	TC	= temperature coefficient
coef	= coefficient	kHz	= kilohertz = 10^{+3} hertz	OD	= outside diameter	TiO_2	= titanium dioxide
com	= common						
comp	= composition	L	= inductor	p	= peak	tog	= toggle
conn	= connection	lin	= linear taper	pc	= printed circuit	tol	= tolerance
		log	= logarithmic taper			trim	= trimmer
dep	= deposited			pF	= picofarad (s) = 10^{-12} farads	TSTR	= transistor
DPDT	= double-pole double-throw	m	= milli = 10^{-3}	piv	= peak inverse voltage	V	= volt (s)
DPST	= double-pole single-throw	mA	= milliampere (s) = 10^{-3} amperes	p/o	= part of	vacw	= alternating current working voltage
		MHz	= megahertz = 10^{+6} hertz	pos	= position (s)		
elect	= electrolytic	MΩ	= megohm-(s) = 10^{+6} ohms	poly	= polystyrene	var	= variable
encap	= encapsulated	met flm	= metal film	pot	= potentiometer	vdcw	= direct current working voltage
		mfr	= manufacturer	p-p	= peak-to-peak		
F	= farad (s)	mtg	= mounting	ppm	= parts per million		
FET	= field effect transistor	mV	= millivolt (s) = 10^{-3} volts	prec	= precision (temperature coefficient, long term stability, and/or tolerance)	W	= watt (s)
fxd	= fixed	μ	= micro = 10^{-6}			w/	= with
		μV	= microvolt (s) = 10^{-6} volts			wiv	= working inverse voltage
GaAs	= gallium arsenide	my	= Mylar ®			w/o	= without
GHz	= gigahertz = 10^{+9} hertz					ww	= wirewound
gd	= guard (ed)	nA	= nanoampere (s) = 10^{-9} amperes	R	= resistor	*	= optimum value selected at factory, average value shown (part may be omitted)
Ge	= germanium	NC	= normally closed	Rh	= rhodium		
grd	= ground (ed)	Ne	= neon	rms	= root-mean-square		
		NC	= normally open	rot	= rotary	**	= no standard type number assigned (selected or special type)
H	= henry (ies)	NPO	= negative positive zero (zero temperature coefficient)	Se	= selenium		
Hg	= mercury			sect	= section (s)		
Hz	= hertz (cycle (s) per second)			Si	= silicon		

rev 8

® Dupont de Nemours

Table 6-1. Replaceable Parts

REFERENCE DESIGNATOR	-hp- PART NO.		TQ	DESCRIPTION	MFR.	MFR. PART NO.
A1	00467-66501		1	Assembly: board, amp and power supply, includes: C101 thru C129 Q101 thru Q112 CR101 thru CR147 R101 thru R165 L101 thru L103	-hp-	00467-66501
A1C101	0170-0019		2	C: fxd, 0.1 μF ±5%	56289	192P10452
A1C102	0150-0060		1	C: fxd, cer die, 1 section, 5.6 pF ±0.25 pF, 500 vdcw	72982	301-011-C0H0-569C
A1C103	0160-0127		5	C: fxd, cer die, 1.0 μF ±20%, 25 vdcw	56289	5C13
A1C104	0150-0121		4	C: fxd, cer die, 0.1 μF +80% -20%, 50 vdcw	56289	5C50A
A1C105	0160-0182		2	C: fxd, dipped mica, 47 pF ±5%	00853	RDM15E470J3S
A1C106	0140-0198		1	C: fxd, dipped mica, 200 pF ±5%	00853	RDM15F201J3C
A1C107, A1C108	0160-0127			C: fxd, cer die, 1.0 μF ±20%, 25 vdcw	56289	5C13
A1C109	0160-0182			C: fxd, dipped mica, 47 pF ±5%	00853	RDM15E470J3S
A1C110	0180-0306		1	C: fxd, Al elect, 300 μF -10% +100%, 15 vdcw	56289	34D307H015FJ4
A1C111	0180-0110		1	C: fxd, Al elect, 80 μF, 75 vdcw	56289	type 41D D33191
A1C112 thru A1C114				Not assigned		
A1C115	0150-0091		1	C: fxd, cer die, 1.5 pF ±0.25 pF, 500 vdcw	72982	301-011-0K0 159C
A1C116	0140-0176		1	C: fxd, dipped mica, 100 pF ±2%	00853	RDM15F101G3C
A1C117	0150-0093		2	C: fxd, 0.01 μF +80% -20%, 100 vdcw	91418	TA obd
A1C118*	0150-0058		3	C: fxd, 2.2 pF,		
A1C119	0150-0121			C: fxd, cer die, 0.1 μF +80% -20%, 50 vdcw	56289	5C50A
A1C120				Not assigned		
A1C121	0160-0127			C: fxd, cer die, 1.0 μF ±20%, 25 vdcw	56289	5C13
A1C122	0150-0063		1	C: fxd, cer die, 10 pF ±0.5 pF, 500 vdcw	72982	301-011-C0G0 100D
A1C123	0140-0146		1	C: fxd, mica die, 82 pF ±5%, 300 vdcw	14655	CD15F820J
A1C124	0132-0004		1	C: var, trimmer, 0.7 to 3 pF, terminal spacing	72982	535-009-4R
A1C125	0180-0039		2	C: fxd, elect, 100 μF, 12 vdcw	56289	D32697
A1C126	0180-0058			C: fxd, elect, 50 μF -10% +100%, 25 vdcw	56289	D28110
A1C127	0180-0039			C: fxd, elect, 100 μF, 12 vdcw	56289	D32697
A1C128	0180-0058			C: fxd, elect, 50 μF -10% +100%, 25 vdcw	56289	D28110
A1C129	0150-0093			C: fxd, 0.01 μF +80% -20%, 100 vdcw	91418	TA obd
A1CR101, A1CR102	1901-0150		2	Diode: Si, low leakage, low capacitance	-hp-	1901-0150
A1CR103	1901-0040		2	Diode: Si, 30 mA at +1 V, 30 piv, 2 pF, 2 ns	-hp-	1901-0040
A1CR104	1902-0048		5	Diode: breakdown, 6.81 V ±5%, 400 mW	-hp-	1902-0048
A1CR105, A1CR106	1901-0025		20	Diode: Si, 50 mA at +1 V, 100 piv, 12 pF	-hp-	1901-0025
A1CR107	1901-0050		1	Diode: Si, 75 V working, 2 pF, 2 ns, 200 mA/+1 V	-hp-	1901-0050
A1CR108 thru A1CR110	1901-0025			Diode: Si, 50 mA at +1 V, 100 piv, 12 pF	-hp-	1901-0025
A1CR111 thru A1CR113	1910-0016		3	Diode: Ge, 100 mA at +0.85 V, 60 V working	-hp-	1910-0016
A1CR114	1901-0040			Diode: Si, 30 mA at +1 V, 30 piv, 2 pF, 2 ns	-hp-	1901-0040
A1CR115	1902-0048			Diode: breakdown, 6.81 V ±5%, 400 mW	-hp-	1902-0048
A1CR116, A1CR117	1901-0025			Diode: Si, 50 mA at +1 V, 100 piv, 12 pF	-hp-	1901-0025
A1CR118	1902-0048			Diode: breakdown, 6.81 V ±5%, 400 mW	-hp-	1902-0048
A1CR119				Not assigned		

Table 6-1. Replaceable Parts (Cont'd)

REFERENCE DESIGNATOR	-hp- PART NO.		TQ	DESCRIPTION	MFR.	MFR. PART NO.	
A1CR120, A1CR121	1901-0025			Diode: Si, 50 mA at +1 V, 100 piv, 12 pF	-hp-	1901-0025	
A1CR122, A1CR123	1902-0048			Diode: breakdown, 6.81 V ±5%, 400 mW	-hp-	1902-0048	
A1CR124	1902-0186		1	Diode: breakdown, Si, 33.2 V ±5%, 400 mW	-hp-	1902-0186	
A1CR125 thru A1CR128	1901-0168		8	Diode: Si, 200 piv, 0.5 amp	-hp-	1901-0026	
A1CR129 thru A1CR134	1901-0025			Diode: Si, 50 mA at +1 V, 100 piv, 12 pF	-hp-	1901-0025	
A1CR135	1902-3296		2	Diode: breakdown, Si 33.2 V ±2%, 400 mW, glass	-hp-	1902-3296	
A1CR136 thru A1CR139	1901-0158			Diode: Si, 200 piv, 0.5 amp	-hp-	1901-0026	
A1CR140 thru A1CR142	1901-0025			Diode: Si, 50 mA at +1 V, 100 piv, 12 pF	-hp-	1901-0025	
A1CR143	1902-3296			Diode: breakdown, Si, 33.2 V ±5%, 400 mW	-hp-	1902-0186	
A1CR144, A1CR145	1901-0025			Diode: Si, 50 mA at +1 V, 100 piv, 12 pF	-hp-	1901-0025	
A1CR146, A1CR147	1902-3139		2	Diode: breakdown, 8.25 V	-hp-	1902-3139	
A1J101	1261-0131		1	Connector: female	00373	69026-1165 (red)	
	1251-0324		1	Connector: male	00373	69026-1064	
A1L101, A1L102	9140-0137		2	Coil: fxd RF, 1000 μH ± 5%, dc current rating 135 mA	-hp-	9140-0137	
A1L103	9140-0096		1	Coil: fxd RF, 1 μH ±10%	-hp-	9140-0096	
A1Q101	1854-0023		3	TSTR: NPN Si	-hp-	1854-0023	
A1Q102	1854-0019		2	TSTR: NPN Si	-hp-	1854-0019	
A1Q103	1854-0023			TSTR: NPN Si	-hp-	1854-0023	
A1Q104	1854-0019			TSTR: NPN Si	-hp-	1854-0019	
A1Q105	1853-0012		2	TSTR: PNP Si, type 2N2904A	-hp-	1853-0012	
A1Q106	1854-0022		1	TSTR: NPN Si	-hp-	1854-0022	
A1Q107	1853-0012			TSTR: PNP Si, type 2N2904A	-hp-	1853-0012	
A1Q108, A1Q109	5080-9023		2	TSTR: matched pair, two 1854-0023 transistors with VBE matched	-hp-	1854-0046	
A1Q110	1854-0023			TSTR: NPN Si	-hp-	1854-0023	
A1Q111, A1Q112	1854-0039		2	TSTR: NPN Si, EIA type 2N3053	86684	2N3053	
A1R101	0698-0076		1	R: fxd, carb flm, 2000 ohms ±5%, 1/2 W	19701	CF1/2C	
A1R102	0757-0787		2	R: fxd, met flm, 392 K ohms ±1%, 1/4 W	75042	CEB T-0	obd
A1R103	0758-0045		4	R: fxd, metal-oxide flm, 3900 ohms ±5%, 1/2 W	07115	C20	obd
A1R104	0758-0006		3	R: fxd, metal-oxide flm, 10 K ohms ±5%, 1/2 W	07115	C20	obd
A1R105	0698-0072		2	R: fxd, met flm, 2.05 K ohms ±1/2%, 1/4 W	76055	CEB T-2	obd
A1R106	0683-2025		1	R: fxd, comp, 2000 ohms ±5%, 1/4 W	01121	CB2025	
A1R107 thru A1R109				Not assigned			
A1R110	0758-0007		1	R: fxd, metal-oxide flm, 150 ohms ±5%, 1/2 W	07115	C20	obd
A1R111	0756-0010		2	R: fxd, metal-oxide flm, 3300 ohms ±5%, 1/2 W	07115	C20	obd
A1R112	0758-0026		1	R: fxd, met flm, 82 ohms ±5%, 1/2 W	-hp-	0758-0026	
A1R113	0758-0010			R: fxd, metal-oxide flm, 3300 ohms ±5%, 1/2 W	07115	C20	obd
A1R114	0758-0005		3	R: fxd, metal-oxide flm, 4700 ohms ±5%, 1/2 W	07115	C20	obd

Table 6-1. Replaceable Parts (Cont'd)

REFERENCE DESIGNATOR	-hp- PART NO.		TQ	DESCRIPTION	MFR.	MFR. PART NO.	
A1R115	0758-0045			R: fxd, metal-oxide film, 3900 ohms ±5%, 1/2 W	07115	C20	obd
A1R116	0758-0005			R: fxd, metal-oxide film, 4700 ohms ±5%, 1/2 W	07115	C20	obd
A1R117	0758-0047		2	R: fxd, metal-oxide film, 7500 ohms, 1/2 W	07115	C20	obd
A1R118	0758-0045			R: fxd, metal-oxide film, 3900 ohms ±5%, 1/2 W	07115	C20	obd
A1R119, A1R120	0758-0053		2	R: fxd, metal-oxide film, 100 K ohms ±5%, 1/2 W	07115	C20	obd
A1R121	0758-0013		1	R: fxd, metal-oxide film, 120 ohms ±5%, 1/2 W	07115	C20	obd
A1R122	0758-0024		3	R: fxd, metal-oxide film, 100 ohms ±5%, 1/2 W	07115	C20	obd
A1R123	0758-0029		1	R: fxd, metal-oxide film, 470 ohms ±5%, 1/2 W	07115	C20	obd
A1R124	0683-1015		1	R: fxd, comp, 100 ohms ±5%, 1/4 W	01121	CB1015	
A1R125	0758-0003		1	R: fxd, metal-oxide film, 1000 ohms ±5%, 1/2 W	07115	C20	obd
A1R126	0758-0070		2	R: fxd, metal-oxide film, 1200 ohms ±5%, 1/2 W	07115	C20	obd
A1R127	0686-3305		1	R: fxd, comp, 33 ohms ±5%, 1/2 W	01121	EB3305	
A1R128	0698-0069		1	R: fxd, 1800 ohms ±5%, 3 W	76055	3 MOL	
A1R129	0757-0756		1	R: fxd, met flm, 13 K ohms ±1%, 1/4 W	75042	CEB T-0	obd
A1R130	0698-0073		1	R: fxd, met flm, 16.2 K ohms ±1/2%, 1/4 W	76055	CEB T-2	obd
A1R131	0698-0072			R: fxd, met flm, 2.05 K ohms ±1/2%, 1/4 W	76055	CEB T-2	obd
A1R132	0727-0312		1	R: fxd, carb flm, 9 M ohms ±1%, 1 W at 70°C, 1/2 W at 125°C	19701	CF 1/2	obd
A1R133	2100-0396		1	R: var, ww, lin taper, 10 K ohms ±20%, 1 W	-hp-	2100-0395	
A1R134	0758-0006			R: fxd, metal-oxide film, 10 K ohms ±5%, 1/2 W	07115	C20	obd
A1R135	0758-0079		1	R: fxd, metal-oxide film, 30 K ohms ±5%, 1/2 W	07115	C20	obd
A1R136	0758-0008		1	R: fxd, metal-oxide film, 390 ohms ±5%, 1/2 W	07115	C20	obd
A1R137				Not assigned			
A1R138	0758-0017		1	R: fxd, metal-oxide film, 1500 ohms ±5% 1/2 W	07115	C20	obd
A1R139	0758-0077		1	R: fxd, metal-oxide film, 75 K ohms ±5%, 1/2 W	07115	C20	obd
A1R140	0758-0049		1	R: fxd, metal-oxide film, 33 K ohms ±5%, 1/2 W	07115	C20	obd
A1R141	0758-0076		1	R: fxd, metal-oxide film, 68 K ohms ±5%, 1/2 W	07115	C20	obd
A1R142	0698-0070		1	R: fxd, met flm, 1.87 K ohms ±1/2%, 1/4 W	75042	CEB T-9	obd
A1R143	0698-0074		1	R: fxd, met flm, 90.9 ohms ±1%, 1/4 W	76055	CEB T-2	obd
A1R144	0698-0075		1	R: fxd, met flm, 17.4 K ohms ±1/2%, 1/4 W	76055	CEB T-9	obd
A1R145	0758-0038		1	R: fxd, metal-oxide film, 9100 ohms ±5%, 1/2 W	07115	C20	obd
A1R146	0758-0047			R: fxd, metal-oxide film, 7500 ohms, 1/2 W	07115	C20	obd
A1R147, A1R148	2100-0898		2	R: var, prec ww, 500 ohms ±5%	-hp-	2100-0898	

Table 6-1. Replaceable Parts (Cont'd)

REFERENCE DESIGNATOR	-hp- PART NO.		TQ	DESCRIPTION	MFR.	MFR. PART NO.	
A1R149, A1R150	0758-0068		2	R: fxd, metal-oxide film, 910 ohms ±5%, 1/2 W	07115	C20	obd
A1R151	0758-0045			R: fxd, metal-oxide film, 3900 ohms ±5%, 1/2 W	07115	C20	obd
A1R152	0758-0070			R: fxd, metal-oxide film, 1200 ohms ±5%, 1/2 W	07115	C20	obd
A1R153	0758-0083		1	R: fxd, metal-oxide film, 1600 ohms ±5%, 1/2 W	07115	C20	obd
A1R154	0758-0035		1	R: fxd, metal-oxide film, 3000 ohms ±5%, 1/2 W	07115	C20	obd
A1R155	0811-0939		1	R: fxd, ww, 100 ohms ±3%, 5 W	00213	1500S	obd
A1R156	0686-4705		1	R: fxd, comp, 47 ohms ±5%, 1/2 W	01121	EB4705	
A1R157	0758-0020		1	R: fxd, metal-oxide film, 22 K ohms ±5%, 1/2 W	07115	C20	obd
A1R158	0758-0015		1	R: fxd, metal-oxide film, 220 ohms ±5%, 1/2 W	07115	C20	obd
A1R159	2100-1415		2	R: var, lin taper, ww, single section, 1 ohm ±10%, 2 W	-hp-	2100-1415	
A1R160	0758-0037		1	R: fxd, metal-oxide film, 5100 ohms ±5%, 1/2 W	07115	C20	obd
A1R161	0761-0013		1	R: fxd, metal-oxide film, 910 ohms ±5%, 1 W	07115	C32	obd
A1R162	0758-0083		2	R: fxd, metal-oxide film, 68 ohms ±5%, 1/2 W	07115	C20	obd
A1R163	2100-1415			R: var, lin taper, ww, single section, 1 ohm ±10%, 2 W	-hp-	2100-1415	
A1R164	0758-0004		1	R: fxd, metal-oxide film, 2.7 K ohms ±5% 1/2 W	07115	C20	obd
A1R165	0758-0005			R: fxd, metal-oxide film, 4700 ohms ±5%, 1/2 W	07115	C20	obd
A2	00467-61901		1	Assembly: switch, amp and supply, includes: C201 thru C203 S201 R201 thru R209	-hp-	00467-61901	
A2C201	0160-0127			C: fxd, cer die, 1.0 μF ±20%, 25 vdcw	56289	5C13	obd
A2C202	0160-0335		1	C: fxd, dipped mica, 91 pF ±1%	00853	RDM15F910F3C	
A2C203	0140-0039		1	C: fxd, molded mica, 47 pF ±5%	00853	RCM15E470J	
A2R201	0698-3143		1	R: fxd, met flm, 52.3 K ohms ±1%, 1/4 W	75042	CEBT-0	obd
A2R202	0698-3144		2	R: fxd, met flm, 8.87 K ohms ±1% 1/4 W	75042	CEB T-0	obd
A2R203	0757-0748		2	R: fxd, met flm, 4.75 K ohms ±1%, 1/4 W	75042	CEB T-0	obd
A2R204	0698-3144			R: fxd, met flm, 8,87 K ohms ±1%, 1/4 W	75042	CEB T-0	obd
A2R205	0757-0746			R: fxd, met flm, 4.75 K ohms ±1%, 1/4 W	75042	CEB T-0	obd
A2R206	0812-0090		1	R: fxd, ww, 5.0094 K ohms ±0.05%, 1/4 W	-hp-	0812-0090	
A2R207	0812-0089		1	R: fxd, ww, 5.0132 K ohms ±0.05%, 1/4 W	-hp-	0812-0089	
A2R208	0812-0088		1	R: fxd, ww, 15.046 K ohms ±0.05%, 1/4 W	-hp-	0812-0088	
A2R209	0812-0087		1	R: fxd, ww, 25 K ohms ±0.05%, 1/4 W	-hp-	0812-0087	
A2S201	3100-0806		1	Switch: rotary, 3 sections	-hp-	3100-0806	
A3	00467-66503		1	Assembly: board, ac input, includes: C301 thru C307 R301 thru R303	-hp-	00467-66503	
A3C301	0121-0060		1	C: var, cer, 2 to 8 pF	-hp-	0121-0060	
A3C302	0160-0161		1	C: fxd, 0.01 μF ±10%	56289	192P10392	
A3C303	0121-0061		1	C: var, cer, disc, 5.5 to 18 pF, NPO, 300 vdcw	-hp-	0121-0061	
A3C304	0170-0066		1	C: fxd, 0.027 μF ±10%	56289	192P27392	
A3C305	0121-0046		1	C: var, cer die, 9 to 35 pF	-hp-	0121-0046	

Table 6-1. Replaceable Parts (Cont'd)

REFERENCE DESIGNATOR	-hp- PART NO.		TQ	DESCRIPTION	MFR	MFR PART NO.	
A3C306	0140-0202		1	C: fxd, dipped mica, 15 pF ±5%	00853	RDM15C150J5C	
A3C307	0170-0019			C: fxd, 0.1 μF ±5%	56289	192P10452	
A3R301	0727-0858		1	R: fxd, depc flm, 3.48 M ohms ±1%, 1/2 W	0000T	CD1/2MR	obd
A3R302	0698-0071		1	R: fxd, depc flm, 1.58 M ohms ±1%	94459	CVC	obd
A3R303	0757-0787			R: fxd, met flm, 392 K ohms ±1%, 1/4 W	75042	CEBT-0	obd
A4	00467-66502		1	Assembly: board, output amplifier, includes: C401 thru C403 R401 thru R411	-hp-	00467-66502	
A4C401, A4C402	0180-0136		2	C: fxd, Al elect, 10 μF -10% +100%, 50 vdcw	56289	40D193A2	
A4C403	0150-0012		2	C: fxd, disc, cer die, 10,000 pF ±20%, 1000 vdcw	71590	13C Disc.	obd
A4R401	0758-0080		1	R: fxd, metal-oxide flm, 75 ohms ±5%, 1/2 W	07115	C20	obd
A4R402	0758-0025		1	R: fxd, metal-oxide flm, 160 ohms ±5%, 1/2 W	07115	C20	obd
A4R403 thru A4R405	0699-0006		4	R: fxd, comp, 4.7 ohms ±10%, 1 W	01121	GB47G1	
A4R406	0758-0083			R: fxd, metal-oxide flm, 68 ohms ±5%, 1/2 W	07115	C20	obd
A4R407	0758-0024			R: fxd, metal-oxide flm, 100 ohms ±5%, 1/2 W	07115	C20	obd
A4R408, A4R409	0699-0001		2	R: fxd, comp, 2.7 ohms ±10%, 1/2 W	01121	EB27G1	
A4R410	0699-0006			R: fxd, comp, 4.7 ohms ±10%, 1 W	01121	CB47G1	
A4R411	0758-0006			R: fxd, metal-oxide flm, 10 K ohms ±5%, 1/2 W	07115	C20	obd
C1	0150-0089		1	C: fxd, cer die, 4.7 pF ±0.25 pF, 500 vdcw	72982	301-011-C0H0-479C	
C2,C3	0180-0359		2	C: fxd, Al elect, 1000 μF -10% +75%, 75 vdcw	56289	D38530	
C4, C5	0150-0121			C: fxd, cer die, 0.1 μF +80% -20%, 50 vdcw	56289	5C50A	
C6	0150-0012			C: fxd, disc, cer die, 10,000 pF ±20%, 1000 vdcw	71590	13 C Disc.	obd
C7, C8	0160-0195		2	C: fxd, cer die, 1000 pF ±20%, 250 vacw	71590	obd	
C9	0140-0149		1	C: fxd, mica die, 470pF ±5%, 300 vdcw	00853	D15F471J	
DS1	2140-0015		1	Lamp: glow, high brightness neon, NE-2H bulb T-2	-hp-	2140-0015	
F1	2110-0020		1	Fuse: cartridge, 0.8 amp, glass body, slow-blow	71400	MDL 8/10	
J1	1251-0135		1	Connector: P.C., 15 tuning fork type contacts	000XX	SD 615 UR	
J2	1251-0141		1	Connector: P.C., 18 tuning fork type contacts	000XX	SD-618 UR	
J3	1510-0008		2	Binding post: red, without solder turret, brass	-hp-	1510-0008	
	1510-0009		2	Binding post: black, without solder turret, brass	-hp-	1510-0009	
	0340-0099		5	Insulator: anti-rotation boss (outer)	-hp-	0340-0099	
	0340-0100		4	Insulator: binding post, grey plastic (inner)	-hp-	0340-0100	
J4	1510-0008			Binding post: red, without solder turret, brass	-hp-	1510-0008	
	5060-0625		1	Assembly: connector	-hp-	5060-0625	
	1510-0009			Binding post: black, without solder turret, brass	-hp-	1510-0009	

Table 6-1. Replaceable Parts (Cont'd)

REFERENCE DESIGNATOR	-hp- PART NO.		TQ	DESCRIPTION	MFR	MFR PART NO	
J4 (Cont'd)	0340-0099			Insulator: anti-rotation boss (outer)	-hp-	0340-0099	
	0340-0100			Insulator: binding post, grey plastic (inner)	-hp-	0340-0100	
J5	1251-0148		1	Connector: pwr, receptacle, 3 pin male	-hp-	1251-0148	
J6				Not assigned			
J7	1251-0473		1	Connector: P.C., 12 ribbon type contacts	-hp-	1251-0473	
J8, J9	1250-0118		2	Connector: series BNC bulkhead receptacle	91737	8427	
K1	0490-0147		1	Relay: coil resistance, 900 ohms, 750 ohms min	-hp-	0490-0147	
L1, L2	9140-0136		2	Coil: fxd RF, 22 μH ±10%	-hp-	9140-0136	
L3	9140-0106		1	Coil: fxd, 0.47 μH ±20%	-hp-	9140-0106	
Q1 thru Q4	1854-0037		4	TSTR: NPN Si	-hp-	1854-0037	
Q5 thru Q8	1850-0098		4	TSTR: PNP Ge	-hp-	1850-0098	
R1	0684-3331		1	R: fxd, comp, 33 K ohms ±10%, 1/4 W	01121	CB3331	
R2, R3	0811-0940		2	R: fxd, ww, 60 ohms ±3%, 50 W	-hp-	0811-0940	
R4	2100-0352		1	R: var, 5 K/50 K ohms ±5%, 2 W	-hp-	2100-0352	
R5	2100-0993		1	R: var, ww, 10 K ohms ±10%, 5 W	-hp-	2100-0993	
R6	0758-0024			R: fxd, metal-oxide film, 100 ohms ±5%, 1/2 W	07115	C20	obd
R7	0727-0018		1	R: fxd, carb film, 40 ohms ±1%, 1/2 W	0000T	CD1/2PR	obd
S1	3101-0036		1	Switch: toggle, SPST, 3 amp, 250 vac-dc	-hp-	3101-0036	
S2	3101-0033		1	Switch: slide, DPDT, non-shorting 0.5 amp 125 vdc, 3 amp 125 vac, 115/230 V	-hp-	3101-0033	
T1	9100-0307		1	Transformer: power	-hp-	9100-0307	
W1	8120-0078		1	Assembly: cable, power, smooth black extra limp, 7.5 ft lg, set	-hp-	8120-0078	
XF1	1400-0084		1	Holder: fuse, extractor post type, for single 3 AG cartridge fuse	-hp-	1400-0084	
				MISCELLANEOUS			
	5040-0235		1	Base: lampholder	-hp-	5040-0235	
	00467-01201		1	Bracket: heat sink	-hp-	00467-01201	
	00467-01202		1	Bracket: rear	-hp-	00467-01202	
	1410-0052		1	Bushing: pot, 0.435" OD by 0.438" lg, nickel plated	-hp-	1410-0052	
	00467-61601		1	Cable assembly: main	-hp-	00467-61601	
	00467-00101		1	Chassis	-hp-	00467-00101	
	5000-0714		1	Cover: bottom, 5 x 11 SM	-hp-	5000-0714	
	5000-0703		2	Cover: side, 6 x 11 SM	-hp-	5000-0703	
	5060-0712		1	Cover: top, assembly, 5 x 11 SM	-hp-	5060-0712	
	5060-0727		2	Foot assembly: third mod	-hp-	5060-0727	
	5060-0703		2	Frame assembly: 6 x 11 SM	-hp-	5060-0703	
	00467-21101		1	Heat sink	-hp-	00467-21101	
	1205-0011		5	Heat sink: TSTR	-hp-	1205-0011	
	1205-0041		1	Heat sink: TSTR	-hp-	1205-0041	
	5040-0700		2	Hinge	-hp-	5040-0700	
	5040-0425		4	Insulator: BNC panel	-hp-	5040-0425	
	1200-0043		4	Insulator: TSTR, mtg, anodized Al plate	-hp-	1200-0043	
	0370-0077		1	Knob: bar	-hp-	0370-0077	

Table 6-1. Replaceable Parts (Cont'd)

REFERENCE DESIGNATOR	-hp- PART NO.		TQ	DESCRIPTION	MFR	MFR. PART NO.
				MISCELLANEOUS (Cont'd)		
	0370-0084		1	Knob: round, black, 5/8" diam, for 1/4" diam shaft	-hp-	0370-0084
	5040-0234		1	Lampholder	-hp-	5040-0234
	00467-90003		1	Manual: serial prefix 444	-hp-	00467-90003
	00467-00201		1	Panel: front	-hp-	00467-00201
	00467-00202		1	Panel: rear	-hp-	00467-00202
	1520-0001		2	Plate: mtg, bakelite, oval shape	-hp-	1520-0001
	5020-0700		1	Spacer: cab, third mod	-hp-	5020-0700
	00467-24701		2	Spacer: heat sink	-hp-	00467-24701
	1490-0031		1	Stand: third module tilt, stainless steel rod	-hp-	1490-0031
	1200-0080		8	Washer: insulating, hard anodized Al, ID for 10-32 screw	-hp-	1200-0080

CODE LIST OF MANUFACTURERS

The following code numbers are from the Federal Supply Code for Manufacturers Cataloging Handbooks H4-1 (Name to Code) and H4-2 (Code to Name) and their latest supplements. The date of revision and the date of the supplements used appear at the bottom of each page. Alphabetical codes have been arbitrarily assigned to suppliers not appearing in the H4 Handbooks.

Code No.	Manufacturer	Address
00000	U.S.A. Common	Any supplier of U.S.
00136	McCoy Electronics	Mount Holly Springs, Pa.
00213	Sage Electronics Corp.	Rochester, N.Y.
00287	Comco Inc.	Danielson, Conn.
00334	Humidial	Colton, Calif.
00348	Microlon Co., Inc.	Valley Stream, N.Y.
00373	Garlock Inc.	Cherry Hill, N.J.
00656	Aerovox Corp.	New Bedford, Mass.
00779	Amp, Inc.	Harrisburg, Pa.
00781	Aircraft Radio Corp.	Boonton, N.J.
00815	Northern Engineering Laboratories, Inc.	Burlington, Wis.
00853	Sangamo Electric Co., Pickens Div.	Pickens, S.C.
00866	Goe Engineering Co.	City of Industry, Cal.
00891	Carl E. Holmes Corp.	Los Angeles, Calif.
00929	Microlab Inc.	Livingston, N.J.
01002	General Electric Co., Capacitor Dept.	Hudson Falls, N.Y.
01009	Alden Products Co.	Brockton, Mass.
01121	Allen Bradley Co.	Milwaukee, Wis.
01255	Litton Industries, Inc.	Beverly Hills, Calif.
01281	TRW Semiconductors, Inc.	Lawndale, Calif.
01295	Texas Instruments, Inc., Transistor Products Div.	Dallas, Texas
01349	The Alliance Mfg. Co.	Alliance, Ohio
01589	Pacific Relays, Inc.	Van Nuys, Calif.
01670	Gudebrod Bros. Silk Co.	New York, N.Y.
01930	Amerock Corp.	Rockford, Ill.
01961	Pulse Engineering Co.	Santa Clara, Calif.
02114	Ferroxcube Corp. of America	Saugerties, N.Y.
02116	Wheelock Signals, Inc.	Long Branch, N.J.
02286	Cole Rubber and Plastics Inc.	Sunnyvale, Calif.
02660	Amphenol-Borg Electronics Corp.	Broadview, Ill.
02735	Radio Corp. of America, Semiconductor and Materials Div.	Somerville, N.J.
02771	Vocaline Co. of America, Inc.	Old Saybrook, Conn.
02777	Hopkins Engineering Co.	San Fernando, Calif.
02825	Hudson Tool & Die Co.	Newark, N.J.
03508	G.E. Semiconductor Prod. Dept.	Syracuse, N.Y.
03705	Apex Machine & Tool Co.	Dayton, Ohio
03797	Eldema Corp.	Compton, Calif.
03818	Parker Seal Co.	Los Angeles, Calif.
03877	Transitron Electric Corp.	Wakefield, Mass.
03888	Pyrofilm Resistor Co., Inc.	Cedar Knolls, N.J.
03954	Singer Co., Diehl Div. Finderne Plant	Somerville, N.J.
04009	Arrow, Hart and Hegeman Elect. Co.	Hartford, Conn.
04013	Tautus Corp.	Lambertville, N.J.
04062	Arco Electronic Inc.	Great Neck, N.Y.
04222	Hi-Q Division of Aerovox	Myrtle Beach, S.C.
04354	Precision Paper Tube Co.	Wheeling, Ill.
04404	Dymec Division of Hewlett-Packard Co.	Palo Alto, Calif.
04651	Sylvania Electric Products, Microwave Device Div.	Mountain View, Calif.
04673	Dakota Engr. Inc.	Culver City, Calif.
04713	Motorola, Inc., Semiconductor Prod. Div.	Phoenix, Arizona
04732	Filtron Co., Inc. Western Div.	Culver City, Calif.
04773	Adinmatic Electric Co.	Northlake, Ill.
04796	Sequoia Wire Co.	Redwood City, Calif.
04811	Precision Coil Spring Co.	El Monte, Calif.
04870	P.M. Motor Company	Westchester, Ill.
04919	Component Mfg. Service Co.	W. Bridgewater, Mass.
05006	Twentieth Century Plastics, Inc.	Los Angeles, Calif.
05245	Components Corp.	Chicago, Ill.
05277	Westinghouse Electric Corp. Semi-Conductor Dept.	Youngwood, Pa.
05347	Dillonia, Inc.	San Mateo, Calif.
05397	Union Carbide Corp., Elect. Div.	New York, N.Y.
05574	Viking Ind. Inc.	Canoga Park, Calif.
05593	Ideal Electro-Plastics Inc.	Sunnyvale, Calif.
05616	Cosmo Plastic (c/o Electrical Spec. Co.)	Cleveland, Ohio
05624	Barber Colman Co.	Rockford, Ill.
05728	Tiffen Optical Co.	Roslyn Heights, Long Island, N.Y.
05729	Metro-Tel Corp.	Westbury, N.Y.
05783	Stewart Engineering Co.	Santa Cruz, Calif.
05820	Wakefield Engineering Inc.	Wakefield, Mass.
06004	Bassick Co., Div. of Stewart Warner Corp.	Bridgeport, Conn.
06090	Raychem Corp.	Redwood City, Calif.
06175	Bausch and Lomb Optical Co.	Rochester, N.Y.
06402	E.T.A. Products Co. of America	Chicago, Ill.
06540	Amatom Electronic Hardware Co., Inc.	New Rochelle, N.Y.
06555	Beede Electrical Instrument Co., Inc.	Penacook, N.H.
06666	General Devices Co., Inc.	Indianapolis, Ind.
06751	Compaonents Inc., Ariz. Div.	Phoenix, Ariz.
06812	Torrington Mfg. Co., West Div.	Van Nuys, Calif.
06980	Varian Assoc. Eimac Div.	San Carlos, Calif.
07088	Kelvin Electric Co.	Van Nuys, Calif.
07126	Digitran Co.	Pasadena, Calif.
07137	Transistor Electronics Corp.	Minneapolis, Minn.
07138	Westinghouse Electric Corp. Electronic Tube Div.	Elmira, N.Y.
07149	Filmohm Corp.	New York, N.Y.
07233	Cinch-Graphik Co.	City of Industry, Calif.
07256	Silicon Transistor Corp.	Cutle Place, N.Y.
07281	Avnet Corp.	Culver City, Calif.
07263	Fairchild Camera & Inst. Corp. Semiconductor Div.	Mountain View, Calif.
07322	Minnesota Rubber Co.	Minneapolis, Minn.
07387	Butcher Corp., The	Monterey Park, Calif.
07397	Sylvania Elect. Prod. Inc., Mt. View Operations	Mountain View, Calif.
07700	Technical Wire Products Inc.	Cranford, N.J.
07829	Bodine Elect. Co.	Chicago, Ill.
07910	Continental Device Corp.	Hawthorne, Calif.
07933	Raytheon Mfg. Co., Semiconductor Div.	Mountain View, Calif.
07980	Hewlett-Packard Co., Boonton Radio Div.	Rockaway, N.J.
08145	U.S. Engineering Co.	Los Angeles, Calif.
08289	Bliss, Deibert Co.	Pomona, Calif.
08358	Burgess Battery Co.	Niagara Falls, Ontario, Canada
08524	Deutsch Fastener Corp.	Los Angeles, Calif.
08654	Bristol Co., The	Waterbury, Conn.
08717	Sloan Company	Sun Valley, Calif.
09718	ITT Cannon Electric Inc., Phoenix Div.	Phoenix, Arizona
08727	National Radio Lab, Inc.	Paramus, N.J.
08792	CBS Electronics Semiconductor Operations, Div of C.B.S. Inc.	Lowell, Mass.
08806	General Electric Co. Miniat. Lamp Dept.	Cleveland, Ohio
08984	Mel-Bain	Indianapolis, Ind.
09026	Babcock Relays Div.	Costa Mesa, Calif.
09134	Texas Capacitor Co.	Houston, Texas
09145	Tech. Ind. Inc. Atohm Elect.	Burbank, Calif.
09259	Electro Assemblies, Inc.	Chicago, Ill.
09353	C & K Components Inc.	Newton, Mass.
09560	Mallory Battery Co. of Canada, Ltd.	Toronto, Ontario, Canada
09922	Burndy Corp.	Norwalk, Conn.
10214	General Translator Western Corp.	Los Angeles, Calif.
10411	Ti-Tal, Inc.	Berkeley, Calif.
10646	Carborundum Co.	Niagara Falls, N.Y.
11236	CTS of Berne, Inc.	Berne, Ind.
11237	Chicago Telephone of California, Inc.	So. Pasadena, Calif.
11242	Bay State Electronics Corp.	Waltham, Mass.
11312	Tetedyne Inc., Microwave Div.	Palo Alto, Calif.
11314	National Seal	Downey, Calif.
11453	Precision Connector Corp.	Jamaica, N.Y.
11534	Duncan Electronics Inc.	Costa Mesa, Calif.
11711	General Instrument Corp., Semiconductor Div., Products Group	Newark, N.J.
11717	Imperial Electronic, Inc.	Buena Park, Calif.
11870	Melabs, Inc.	Palo Alto, Calif.
12040	National Semiconductor	Danbury, Conn.
12136	Philadelphia Handle Co.	Camden, N.J.
12361	Grove Mfg. Co., Inc.	Shady Grove, Pa.
12576	Gulton Ind. Inc. Data System Div.	Albuquerque, N.M.
12697	Clarostat Mfg. Co.	Dover, N.H.
12728	Elmar Filter Corp.	W. Haven, Conn.
12859	Nippon Electric Co., Ltd.	Tokyo, Japan
12881	Metex Electronics Corp.	Clark, N.J.
12930	Delta Semiconductor Inc.	Newport Beach, Calif.
12954	Dickson Electronics Corp.	Scottsdale, Arizona
13103	Thermoloy	Dallas, Texas
13396	Telefunken (GmbH)	Hanover, Germany
13835	Midland-Wright Div. of Pacific Industries, Inc.	Kansas City, Kansas
14099	Sem-Tech	Newbury Park, Calif.
14193	Calif. Resistor Corp.	Santa Monica, Calif.
14298	American Components, Inc.	Conshohocken, Pa.
14433	ITT Semiconductors, A Div. of Int. Telephone & Telegraph Corp.	West Palm Beach, Fla.
14493	Hewlett-Packard Company	Loveland, Colo.
14655	Cornell Dubilier Electric Corp.	Newark, N.J.
14674	Corning Glass Works	Corning, N.Y.
14752	Electro Cube Inc.	San Gabriel, Calif.
14936	Williams Mfg. Co.	San Jose, Calif.
15203	Webster Electronics Co.	New York, N.Y.
15287	Sonotics Corp.	Northridge, Calif.
15291	Adjustable Bushing Co.	N. Hollywood, Calif.
15558	Micron Electronics	Garden City, Long Island, N.Y.
15566	Aerpiobe Inst. Corp.	Lynbrook, N.Y.
15631	Cabletronics	Costa Mesa, Calif.
15772	Twentieth Century Coil Spring Co.	Santa Clara, Calif.
15801	Fenwal Elect. Inc.	Framingham, Mass.
15818	Amelco Inc.	Mt. View, Calif.
15937	Spruce Pine Mica Co.	Spruce Pine, N.C.
16179	Omni-Spectra Inc.	Farmington, Mich.
16352	Computel Oxide Corp.	Lodi, N.J.
16585	Boots Aircraft Nut Corp.	Pasadena, Calif.
16588	Ideal Prec. Meter Co., Inc. De Jur Meter Div.	Brooklyn, N.Y.
18756	Delco Radio Div. of G.M. Corp.	Kokomo, Ind.
17109	Thermonetics Inc.	Canoga Park, Calif.
17474	Texnox Company	Mountain View, Calif.
17554	Components Inc.	Biddeford, Me.
17675	Hamlin Metal Products Corp.	Akron, Ohio
17745	Angstrohm Prec. Inc.	No. Hollywood, Calif.

CODE LIST OF MANUFACTURERS (Continued)

Code No.	Manufacturer	Address
17870	McGraw-Edison Co.	Manchester, N.H.
18042	Power Designs Pacific Inc.	Palo Alto, Calif.
18083	Cleville Corp., Semiconductor Div.	Palo Alto, Calif.
18324	Signetics Corp.	Sunnyvale, Calif.
18476	Ty-Car Mfg. Co., Inc.	Hollister, Mass.
18486	TRW Elect. Comp. Div.	Des Plaines, Ill.
18583	Curtis Instrument, Inc.	Mt. Kisco, N.Y.
18612	Vishay Instruments Inc.	Malvern, Pa.
18673	E.I. DuPont and Co., Inc.	Wilmington, Del.
18911	Durant Mfg. Co.	Milwaukee, Wis.
19315	The Bendix Corp., Navigation & Control Div.	Teterboro, N.J.
19500	Thomas A. Edison Industries, Div. of McGraw-Edison Co.	West Orange, N.J.
19589	Conoco	Baldwin Park, Calif.
19644	LRC Electronics	Horseheads, N.Y.
19701	Electra Mfg. Co.	Independence, Kansas
20183	General Atronics Corp.	Philadelphia, Pa.
21226	Executone, Inc.	Longisland City, N.Y.
21335	Fafnir Bearing Co., The	New Britain, Conn.
21520	Fanstael Metallurgical Corp.	N. Chicago, Ill.
23042	Texscan Corp.	Indianapolis, Ind.
23783	British Radio Electronics Ltd.	Washington, D.C.
24455	G.E. Lamp Division	Nela Park, Cleveland, Ohio
24655	General Radio Co.	West Concord, Mass.
24681	Memcor Inc., Comp. Div.	Huntington, Ind.
24796	Perelco Inc.	San Juan Capistrano, Calif.
26365	Gries Reproducer Corp.	New Rochelle, N.Y.
26452	Global Fite Co. of America, Inc.	Carlstadt, N.J.
26951	Compac/Hollister Co.	Hollister, Calif.
26992	Hamilton Watch Co.	Lancaster, Pa.
27251	Specialities Mfg. Co., Inc.	Stratford, Conn.
28480	Hewlett-Packard Co.	Palo Alto, Calif.
28520	Heyman Mfg. Co.	Kenilworth, N.J.
30817	Instrument Specialties Co., Inc.	Little Falls, N.J.
33173	G.E. Receiving Tube Dept.	Owensboro, Ky.
35434	Lectrohm Inc.	Chicago, Ill.
36196	Stanwyck Coil Products Ltd.	Hawkesbury, Ontario, Canada
36287	Cunningham, W.H. & Hill, Ltd.	Toronto Ontario, Canada
37942	P.R. Mallory & Co. Inc.	Indianapolis, Ind.
39543	Mechanical Industries Prod. Co.	Akron, Ohio
40920	Miniature Precision Bearings, Inc.	Keene, N.H.
42190	Muter Co.	Chicago, Ill.
43990	C.A. Naugton Co.	Englewood, Colo.
44655	Ohmite Mfg. Co.	Skokie, Ill.
46384	Penn Eng. & Mfg. Corp.	Doylestown, Pa.
47904	Polaroid Corp.	Cambridge, Mass.
48620	Precision Thermometer & Inst. Co.	Southampton, Pa.
49956	Microwave & Power Tube Div.	Waltham, Mass.
52090	Rowan Controller Co.	Westminster, Md.
52983	Sanborn Company	Waltham, Mass.
54294	Shallcross Mfg. Co.	Selma, N.C.
55026	Simpson Electric Co.	Chicago, Ill.
55933	Sonotone Corp.	Elmsford, N.Y.
55938	Raytheon Co. Commercial Apparatus & Systems Div.	So. Norwalk, Conn.
56137	Spaulding Fibre Co., Inc.	Tonawanda, N.Y.
56289	Sprague Electric Co.	North Adams, Mass.
59446	Telex Corp.	Tulsa, Okla.
59730	Thomas & Betts Co.	Elizabeth, N.J.
60741	Triplett Electrical Inst. Co.	Bluffton, Ohio
61775	Union Switch and Signal, Div. of Westinghouse Air Brake Co.	Pittsburgh, Pa.
62119	Universal Electric Co.	Owosso, Mich.
63743	Ward-Leonard Electric Co.	Mt. Vernon, N.Y.
64959	Western Electric Co., Inc.	New York, N.Y.
65092	Weston Inst. Inc. Weston-Newark	Newark, N.J.
66295	Willek Mfg. Co.	Chicago, Ill.
66346	Minnesota Mining & Mfg. Co. Revere Mincom Div.	St. Paul, Minn.
70276	Allen Mfg. Co.	Hartford, Conn.
70309	Allied Control	New York, N.Y.
70318	Allmetal Screw Product Co., Inc.	Garden City, N.Y.
70417	Amplex, Div. of Chrysler Corp.	Detroit, Mich.
70485	Atlantic India Rubber Works, Inc.	Chicago, Ill.
70563	Amperite Co., Inc.	Union City, N.J.
70674	ADC Products Inc.	Minneapolis, Minn.
70903	Belden Mfg. Co.	Chicago, Ill.
70998	Bild Electronic Corp.	Cleveland, Ohio
71002	Birnbach Radio Co.	New York, N.Y.
71034	Billey Electric Co., Inc.	Erie, Pa.
71041	Boston Gear Works Div. of Murray Co. of Texas	Quincy, Mass.
71218	Bud Radio, Inc.	Willoughby, Ohio
71279	Cambridge Thermionics Corp.	Cambridge, Mass.
71285	Camloc Fastener Corp.	Paramus, N.J.
71313	Cardwell Condenser Corp.	Lindenhurst L.I., N.Y.
71400	Bussmann Mfg. Div. of McGraw-Edison Co.	St. Louis, Mo.
71436	Chicago Condenser Corp.	Chicago, Ill.
71447	Calif. Spring Co., Inc.	Pico-Rivera, Calif.
71450	CTS Corp.	Elkhart, Ind.
71468	ITT Cannon Electric Inc.	Los Angeles, Calif.
71471	Cinema, Div. Aerovox Corp.	Burbank, Calif.
71482	C.P. Clare & Co.	Chicago, Ill.
71590	Centralab Div. of Globe Union Inc.	Milwaukee, Wis.
71616	Commercial Plastics Co.	Chicago, Ill.
71700	Cornish Wire Co., The	New York, N.Y.
71707	Coto Coil Co., Inc.	Providence, R.I.
71744	Chicago Miniature Lamp Works	Chicago, Ill.
71785	Cinch Mfg. Co., Howard B. Jones Div.	Chicago, Ill.
71984	Dow Corning Corp.	Midland, Mich.
72136	Electro Motive Mfg. Co., Inc.	Willimantic, Conn.
72619	Dialight Corp.	Brooklyn, N.Y.
72656	Indiana General Corp., Electronics Div.	Keasby, N.J.
72699	General Instrument Corp., Cap. Div.	Newark, N.J.
72765	Drake Mfg. Co.	Harwood Heights, Ill.
72825	Hugh H. Eby Inc.	Philadelphia, Pa.
72928	Gudeman Co.	Chicago, Ill.
72962	Elastic Stop Nut Corp.	Union, N.J.
72964	Robert M. Hadley Co.	Los Angeles, Calif.
72982	Erie Technological Products, Inc.	Erie, Pa.
73061	Henson Mfg. Co., Inc.	Princeton, Ind.
73076	H.M. Harper Co.	Chicago, Ill.
73138	Helipot Div. of Beckman Inst., Inc.	Fullerton, Calif.
73293	Hughes Products Division of Hughes Aircraft Co.	Newport Beach, Calif.
73445	Amperex Elect Co.	Hicksville, L.I., N.Y.
73506	Bradley Semiconductor Corp.	New Haven, Conn.
73559	Carling Electric, Inc.	Hartford, Conn.
73586	Circle F Mfg. Co.	Trenton, N.J.
73682	George K. Garrett Co., Div. MSL Industries Inc.	Philadelphia, Pa.
73734	Federal Screw Products Inc.	Chicago, Ill.
73743	Fischer Special Mfg. Co.	Cincinnati, Ohio
73793	General Industries Co., The	Elyria, Ohio
73846	Goshen Stamping & Tool Co.	Goshen, Ind.
73899	JFD Electronics Corp.	Brooklyn, N.Y.
73905	Jennings Radio Mfg. Corp.	San Jose, Calif.
73957	Groov-Pin Corp.	Ridgefield, N.J.
74276	Signalite Inc.	Neptune, N.J.
74455	J.H. Winns, and Sons	Winchester, Mass.
74861	Industrial Condenser Corp.	Chicago, Ill.
74868	R.F. Products Divisionof Amphenol-Borg Electronics Corp.	Danbury, Conn.
74970	E.F. Johnson Co.	Waseca, Minn.
75042	International Resistance Co.	Philadelphia, Pa.
75263	Keystone Carbon Co., Inc.	St. Marys, Pa.
75378	CTS Knights Inc.	Sandwich, Ill.
75382	Kulka Electric Corporation	Mt. Vernon, N.Y.
75818	Lenz Electric Mfg. Co.	Chicago, Ill.
75915	Littelfuse, Inc.	Des Plaines, Ill.
76005	Lord Mfg. Co.	Erie, Pa.
76210	C.W. Marwedel	San Francisco, Calif.
76483	General Instrument Corp., Micamold Division	Newark, N.J.
76487	James Millen Mfg. Co., Inc.	Malden, Mass.
76493	J.W. Miller Co.	Los Angeles, Calif.
76530	Cinch-Monadnock, Div. of United Carr Fastener Corp.	San Leandro, Calif.
76545	Moeller Electric Co.	Cleveland, Ohio
76703	National Union	Newark, N.J.
76854	Oak Manufacturing Co.	Crystal Lake, Ill.
77068	The Bendix Corp., Electrodynamics Div.	N. Hollywood, Calif.
77075	Pacific Metals Co.	San Francisco, Calif.
77221	Phaostron Instrument and Electronic Co.	South Pasadena, Calif.
77252	Philadelphia Steel and Wire Corp.	Philadelphia, Pa.
77342	American Machine & Foundry Co. Potter & Brumfield Div.	Princeton, Ind.
77630	TRW Electronic Components Div.	Camden, N.J.
77638	General Instrument Corp., Rectifier Div.	Brooklyn, N.Y.
77764	Resistance Products Co.	Harrisburg, Pa.
77969	Robbercraft Corp. of Calif.	Torrance, Calif.
78189	Shakeproof Division of Illinois Tool Works	Elgin, Ill.
78277	Sigma	So. Braintree, Mass.
78283	Signal Indicator Corp.	New York, N.Y.
78290	Stuthers-Dunn Inc.	Pitman, N.J.
78424	Specialty Leather Prod. Co.	Newark, N.J.
78452	Thompson-Bremer & Co.	Chicago, Ill.
78471	Tilley Mfg. Co.	San Francisco, Calif.
78488	Stackpole Carbon Co.	St. Marys, Pa.
78493	Standard Thomson Corp.	Waltham, Mass.
78553	Tinnerman Products, Inc.	Cleveland, Ohio
78790	Transformer Engineers	San Gabriel, Calif.
78947	Ucinite Co.	Newtonville, Mass.
79136	Waldes Kohinoor Inc.	Long Island City, N.Y.
79142	Veeder Root, Inc.	Hartford, Conn.
79251	Waco Mfg. Co.	Chicago, Ill.
79727	Continental-Wirt Electronics Corp.	Philadelphia, Pa.
79963	Zierick Mfg. Corp.	New Rochelle, N.Y.
80031	Mepco Division of Sessions Clock Co.	Morristown, N.J.
80120	Schnitzer Alloy Products Co.	Elizabeth, N.J.
80131	Electronic Industries Association, Any brand Tube meeting EIA Standards-Washington, DC.	
80207	Unimax Switch, Div. Maxco Electronics Corp.	Wallingford, Conn.
80223	United Transformer Corp.	New York, N.Y.
80248	Oxford Electric Corp.	Chicago, Ill.
80294	Bourns Inc.	Riverside, Calif.
80411	Acro Div. of Rheitshaw Controls Co.	Columbus, Ohio

CODE LIST OF MANUFACTURERS (Continued)

Code No.	Manufacturer	Address
80486	All Star Products Inc.	Defiance, Ohio
80509	Avery Label Co.	Monrovia, Calif.
80583	Hammerlund Co., Inc.	Mars Hill, N.C.
80640	Stevens, Arnold, Co., Inc.	Boston, Mass.
80813	Dimco Gray Co.	Dayton, Ohio
81030	International Instruments Inc.	Orange, Conn.
81073	Grayhill Co.	LaGrange, Ill.
81095	Triad Transformer Corp.	Venice, Calif.
81312	Winchester Elec. Div. Litton Ind., Inc.	Oakville, Conn.
81349	Military Specification	
81483	International Rectifier Corp.	El Segundo, Calif.
81541	Airpax Electronics, Inc.	Cambridge, Maryland
81860	Barry Controls, Div. Barry Wright Corp.	Watertown, Mass.
82042	Carter Precision Electric Co.	Skokie, Ill.
82047	Sperti Faraday Inc., Copper Hewill Electric Div.	Hoboken, N.J.
82116	Electric Regulator Corp.	Norwalk, Conn.
82142	Jeffers Electronics Division of Speer Carbon Co.	Du Bois, Pa.
82170	Fairchild Camera & Inst. Corp. Space & Defense System Div.	Paramus, N.J.
82209	Magnetic Industries, Inc.	Greenwich, Conn.
82219	Sylvania Electric Prod. Inc. Electronic Tube Division	Emporium, Pa.
82376	Astron Corp.	East Newark, Harrison, N.J.
82389	Switchcraft, Inc.	Chicago, Ill.
82647	Metals & Controls Inc. Spencer Products	Attleboro, Mass.
82768	Phillips-Advance Control Co.	Joliet, Ill.
82866	Research Products Corp.	Madison, Wis.
82877	Rotron Mfg. Co., Inc.	Woodstock, N.Y.
82893	Vector Electronic Co.	Glendale, Calif.
83014	Hartwell Corp.	Los Angeles, Calif.
83058	Carr Fastener Co.	Cambridge, Mass.
83086	New Hampshire Ball Bearing, Inc.	Peterborough, N.H.
83125	General Instrument Corp., Capacitor Div.	Darlington, S.C.
83148	ITT Wire and Cable Div.	Los Angeles, Calif.
83186	Victory Eng. Corp.	Springfield, N.J.
83298	Bendix Corp., Red Bank Div.	Red Bank, N.J.
83315	Hubbell Corp.	Mundelein, Ill.
83324	Rosan Inc.	Newport Beach, Calif.
83330	Smith, Herman H., Inc.	Brooklyn, N.Y.
83332	Tech Labs	Palisade's Park, N.J.
83385	Central Screw Co.	Chicago, Ill.
83501	Gavill Wire and Cable Co. Div. of Ameraca Corp.	Brookfield, Mass.
83594	Burroughs Corp. Electronic Tube Div.	Plainfield, N.J.
83740	Union Carbide Corp. Consumer Prod. Div.	New York, N.Y.
83777	Model Eng. and Mfg., Inc	Huntington, Ind.
83821	Loyd Scruggs Co.	Festus, Mo.
83942	Aeronautical Inst. & Radio Co.	Lodi, N.J.
84171	Arco Electronics Inc.	Great Neck, N.Y.
84396	A.J. Glesener Co., Inc.	San Francisco, Calif.
84411	TRW Capacitor Div.	Ogallala, Neb.
84970	Sarkes Tarzian, Inc.	Bloomington, Ind.
85454	Boonton Molding Company	Boonton, N.J.
85471	A.B. Boyd Co.	San Francisco, Calif.
85474	R.M. Bracamonte & Co.	San Francisco, Calif.
85660	Coiled Cords, Inc.	Hamden, Conn.
85911	Seamless Rubber Co	Chicago, Ill.
86174	Fafnir Bearing Co.	Los Angeles, Calif.
86197	Cliftoo Precision Products Co., Inc.	Clifton Heights, Pa.
86679	Precision Rubber Products Corp.	Dayton, Ohio
86684	Radio Corp. of America, Electronic Comp. & Devices Div.	Harrison, N.J.
86928	Seastrom Mfg. Co.	Glendale, Calif.
87034	Marco Industries	Anaheim, Calif.
87218	Philco Corporation (Lansdale Division)	Lansdale, Pa.
87473	Western Fibrous Glass Products Co.	San Francisco, Calif.
87664	Van Waters & Rogers Inc.	San Francisco, Calif.
87930	Tower Mfg. Corp.	Providence, R.I.
88140	Cutler-Hammer, Inc.	Lincoln, Ill.
88220	Gould-National Batteries, Inc.	St. Paul, Minn.
88698	General Mills, Inc.	Buffalo, N.Y.
89231	Glayhar Electric Co.	Oakland, Calif.
89473	G.E. Distributing Corp.	Schenectady, N.Y.
89665	United Transformer Co.	Chicago, Ill.
90830	United Shoe Machinery Corp.	Beverly, Mass.
90179	US Rubber Co., Consumer Ind. & Plastics Prod. Div.	Passaic, N.J.
90970	Bearing Engineering Co.	San Francisco, Calif.
91146	ITT Cannon Elect. Inc., Salem Div. Salem, Mass.	
91260	Conner Spring Mfg. Co.	San Francisco, Calif.
91345	Miller Dial & Nameplate Co.	El Monte, Calif.
91416	Radio Materials Co.	Chicago, Ill.
91506	Aqua Inc.	Attleboro, Mass.
91637	Dale Electronics, Inc.	Columbus, Nebr.
91662	Elco Corp.	Willow Grove, Pa.
91737	Gremar Mfg. Co., Inc.	Wakefield, Mass.
91827	K F Development Co.	Redwood City, Calif.
91886	Melco Mfg. Co., Inc.	Chicago, Ill.
91929	Honeywell Inc., Micro Switch Div.	Freeport, Ill.
91961	Nahm-Bros. Spring Co.	Oakland, Calif.
92180	Tru-Connector Corp.	Peabody, Mass.
92367	Elgeet Optical Co. Inc.	Rochester, N.Y.
92607	Tensolite Insulated Wire Co., Inc.	Tarrytown, N.Y.
92702	IMC Magnetics Corp.	Westbury Long Island, N.Y.
92966	Hudson Lamp Co.	Kearney, N.J.
92332	Sylvania Electric Prod. Inc. Semiconductor Div.	Woburn, Mass.
93369	Robbins & Myers Inc.	Palisades Park, N.J.
93410	Stancо Controls, Div. of EssexWire Corp.	Mansfield, Ohio
93632	Waters Mfg. Co.	Culver City, Calif.
93929	G.V. Controls	Livingston, N.J.
94137	General Cable Corp.	Bayonne, N.J.
94142	Phelps Dodge	Yonkers, N.Y.
94144	Raytheon Co., Comp. Div., Ind. Comp. Operations	Quincy, Mass.
94148	Scientific Electronics Products, Inc.	Loveland, Colo.
94154	Wagner Elect. Corp., Tung-Sol Div. Newark, N.J.	
94197	Curtiss-Wright Corp. Electronics Div.	East Paterson, N.J.
94222	South Chester Corp.	Chester, Pa.
94330	Wire Cloth Products, Inc.	Bellwood, Ill.
94375	Automatic Metal Products Co.	Brooklyn, N.Y.
94687	Worcester Pressed Aluminum Corp.	Worcester, Mass.
94696	Magnecraft Electric Co.	Chicago, Ill.
95023	George A. Philbrick Researchers, Inc.	Boston, Mass.
95236	Allies Products Corp.,	Doola, Fla.
95239	Continental Connector Corp.	Woodside, N.Y.
95263	Lectrall Mfg. Co., Inc.	Long Island, N.Y.
95265	National Coil Co.	Sheridan, Wyo.
95275	Vitramon, Inc.	Bridgeport, Conn.
95348	Gordos Corp.	Bloomfield, N.J.
95354	Methode Mfg. Co.	Rolling Meadows, Ill.
95566	Arnold Engineering Co.	Marengo, Ill.
95712	Dage Electric Co., Inc.	Franklin, Ind.
95984	Siemon Mfg. Co.	Wayne, Ill.
95987	Weckesser Co.	Chicago, Ill.
96067	Microwave Assoc., West Inc.	Sunnyvale, Calif.
96095	Hi Q Div. of Aerovox Corp.	Olean, N.Y.
96256	Thordarson-Meissner Inc.	Mt. Carmel, Ill.
96296	Solar Manufacturing Co.	Los Angeles, Calif.
96306	Microswitch, Div. of Minn.-Honeywell	Freeport, Ill.
96330	Carlton Screw Co.	Chicago, Ill.
96341	Microwave Associates, Inc.	Berlington, Mass.
96501	Excel Transformer Co.	Oakland, Calif.
96733	San Fernando Elect. Mfg. Co.	San Fernando, Calif.
96881	Thomsen Ind. Inc.	Long Is., N.Y.
97464	Industrial Retaining Ring Co.	Irvington, N.J.
97529	Automatic & Precision Mfg.	Englewood, N.J.
97979	Reon Resistor Corp.	Yonkers, N.Y.
97983	Litton System Inc., Adler-Westrex Comeon. Div.	New Rochelle, N.Y.
98141	R-Troncis, Inc.	Jamaica, N.Y.
98159	Rubber Tech. Inc.	Gardena, Calif.
98220	Hewlett-Packard Co., Moseley Div.	Pasadena, Calif.
98278	Microdot, Inc.	So. Pasadena, Calif.
98291	Sealectro Corp.	Mamaroneck, N.Y.
98376	Zero Mfg. Co.	Burbank, Calif.
98410	Elc Inc.	Cleveland, Ohio
98731	General Mills Inc., Electronics Div.	Minneapolis, Minn.
98734	Paeco Div. of Hewrett-Packard Co.	Palo Alto, Calif.
98821	North Hills Electronics, Inc.	Glen Cove, N.Y.
98978	International Electronic Research Corp.	Burbank, Calif.
99109	Columbia Technical Corp.	New York, N.Y.
99313	Varian Associates	Palo Alto, Calif.
99378	Allen Corp.	Winchester, Mass.
99515	Marshall Ind., Capacitor Div.	Mcrorvia, Calif.
99707	Control Switch Division, Controls Co. of America	El Segundo, Calif.
99800	Delevan Electronics Corp.	East Aurora, N.Y.
99848	Wilco Corporation	Indianapolis, Ind.
99928	Bronson Corp.	Whippany, N.J.
99934	Rembrandt, Inc.	Boston, Mass.
99942	Hoffman Electronics Corp. Semiconductor Div.	El Monte, Calif.
99957	Technology Instrument Corp. of Calif.	Newbury Park, Calif.

THE FOLLOWING HP VENDORS HAVE NO NUMBER ASSIGNED IN THE LATEST SUPPLEMENT TO THE FEDERAL SUPPLY CODE FOR MANUFACTURERS HANDBOOK.

0000F	Malco Tool and Die	Los Angeles, Calif.
0000Z	Willow Leather Products Corp.	Newark, N.J.
000AB	ETA	England
000BB	Precision Instrument Components Co.	Van Nuys, Calif.
000CS	Hewlett-Packard Co., Colorado Springs	Colorado Springs, Colorado
000MK	Rubber Eng. & Development	Hayward, Calif.
000NN	A "N" O MIB Co.	San Jose, Calif.
000QQ	Coolirae	Oakland, Calif.
000WW	California Eastern Lab.	Burlington, Calif.
000YY	S.K. Smith Co.	Los Angeles, Calif.

MANUAL CHANGES

MODEL 467A

POWER AMPLIFIER/SUPPLY

Manual Part No. 00467-90003

▮ New or Revised Item

ERRATA

Page 1-0, Table 1-1. Under Accuracy, change "dc to 1 MHz" to "100 kHz to 1 MHz".

Table 5-2. In the "Model 3440A/3445A AC Voltmeter Reading" column the readings for the VAR-CW position are not correct. They should be the same as the values for the X10 position in their respectiverows, e.g., the reading for VAR-CW in the first row should be 9.900 to 10.100 V.

▮ Table5-5. Change CR146 to CR147.

Performance Test Card (following Page 5-10). Change the Test Limits for AC Accuracy and Gain Check for VAR-CW as follows:

	Limits
100 kHz	
VAR-CW	9.900 to 10.100 V
10 kHz	
VAR-CW	9.970 to 10.030 V
400 Hz	
VAR-CW	9.970 to 10.030 V
1 MHz	
VAR-CW	9.00 to 11.00 V

▮ Change the DC Voltage and Current Check from 5 V (CCW to CW) to 4 V and SPECIFICATIONS to > -4.000 V and > +4.000 V.

CHANGE NO. 1 Applies to Serial Numbers 949-02141 and Above.

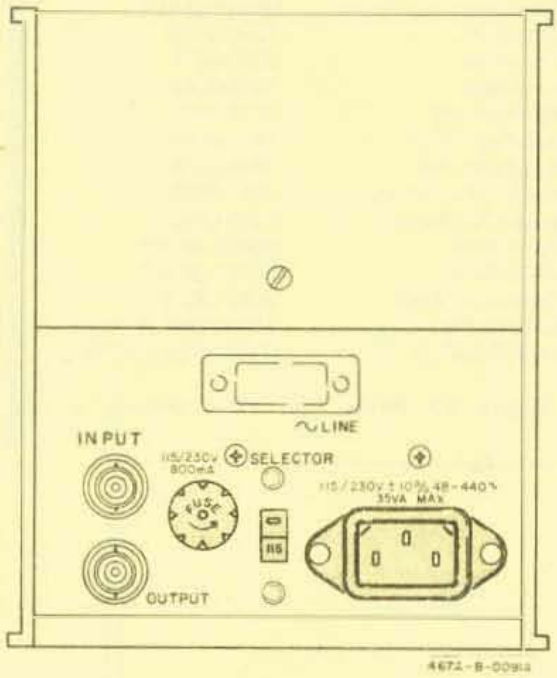
Page 5-13/5-14, Figure 5-14. Change C7, C8 to .005 µF.

Page 6-6, Table 6-1. Change C7, C8 Part No. to 0160-3333 (5000 pF).
Change F1 Part No. to 2110-0336.

Page 6-7, Table 6-1. Change J5 Part No. to 1251-2357.
Change S2 Part No. to 3101-1234.
Change W1 Part No. to 8120-1348.

Page 6-8, Table 6-1. Change rear panel Part No. to 00467-00203.

Page 3-3, Figure 3-2. Revise rear panel drawing as follows:



CHANGE NO. 2 Applies to Serial Numbers 949-02246 and Above.

Page 6-2. Change A1CR114 Part No. and description to 1901-0050 Diode:Si 200mA.

CHANGE NO. 3 Applies to Serial Numbers 994-02386 and Above.

On the following pages and figures the ground symbols will be changed as shown *unless otherwise noted*. Front cover; Page 1-0; Figures 3-1, 4-1 and 5-13; Figure 5-14. (Do not change earth ground from center terminal of J5.)

⏚ is changed to ⏚.
⏚ is changed to ⏚.
⏚ on the printed circuit boards is changed to ⏚.

CHANGE NO. 4 Applies to Serial Numbers 0994A02666 and Above.

Table 6-1. Change Panel:front to 00467-00204, Cover:side to 5000-8565, Cover:bottom to 5000-8577, and Cover:top to 5060-8561.

CHANGE NO. 5 Applies to Serial Numbers 0994A03171 and Above.

Page 5-11/5-12, Page 6-2, Table 6-1. Delete A1CR108 1901-0025.

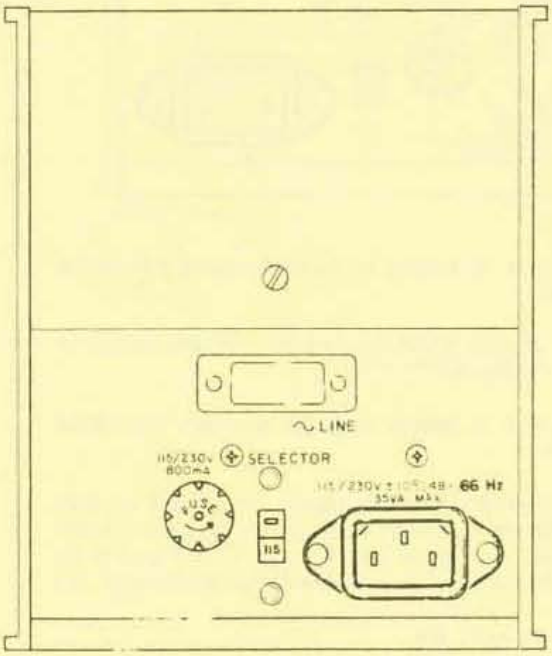
Page 5-13/5-14, Page 6-5, Table 6-1. Change A1R156 to A1R*180. Correct the part number to 0698-4364 17.4 Ω.

CHANGE NO. 6 Applies to Serial Numbers 0994A03221 and Above.

Pages 6-6, 6-7, and 6-8, Table 6-1.

Delete:	Cable Assembly:Main	00467-61601
Add:	Cable Assembly:Main	00467-61611
Delete:	J8 and J9	1250-0118
Delete:	Knob:bar	0370-0077
Add:	Knob:bar	0370-0084
Add:	Knob:round	0370-1099
Delete:	Bdg Post - Red	1510-0008
Delete:	Bdg Post - Blk	1510-0009
Add:	Binding Post Ass'y	1510-0087
Delete:	Insul-BNC Panel	5040-0425
Delete:	Panel-Rear	00467-00203
Add:	Panel-Rear	00467-00213
Delete:	Connector Ass'y	5060-0625
Add:	Binding Post	1510-0084,4 (TQ)
Add:	Insul-Bdg Post	0340-0732,9 (TQ)

Page 3-3, Figure 3-2. Revise Rear Panel Drawing as follows:



Page 5-11/5-12. Delete J8 and J9.

Page 6-6. Delete R401, 75 ohm .05, 0758-0080; R407, 100 ohm .05, 0758-0024; R411, 10 kilohm .05, 0758-0006.
Add R401, 75 ohm .01, 0757-0710; R406,68.1 ohm .01, 0757-0709; R407, 100 ohm .01, 0757-0178; R411, 10.3 kilohm .005,0757-0109.

CHANGE NO. 7 Applies to All Serial Numbers.

Page 1-0, Table 1-1. Under Power Required, change 50 to 400 Hz to 48 to 66 Hz.
Under Input-Output Terminals, delete reference to Rear Panel. (BNC connectors are removed.)
Under Output Impedance, delete (from panel connector).

Page 2-1, Paragraph 2-6. Change 50 to 400 Hz to 48 to 66 Hz.

Page 3-3, Figure 3-2. Delete Index number and description.
On rear panel, change marking 440 (Hz) to 66 (Hz).

Page 5-1. Paragraph 5-9. After paragraph heading add:

NOTE

Do not use low impedance cable (50 Ω). Cable capacity adversely affects frequency response.

CHANGE NO. 8 Applies to Serial Numbers 994A03426 and above.

Page 5-11/5-12. Change A1R150 to 562 (ohms).
Delete Capacitor C6.

Page 6-2. Change A1CR101, A1CR102 to 1901-0376.

Page 6-6. Delete Capacitor C6.

MANUAL CHANGES

MODEL 467A

POWER AMPLIFIER/SUPPLY

-hp- Part No. 00467-90003

► New or revised item

Instrument Serial Number	Make Manual Changes
949-02141 and above	#1
949-02246 and above	#1, #2
994-02386 and above	#1, #2, #3

Instrument Serial Number	Make Manual Changes

CHANGE #1

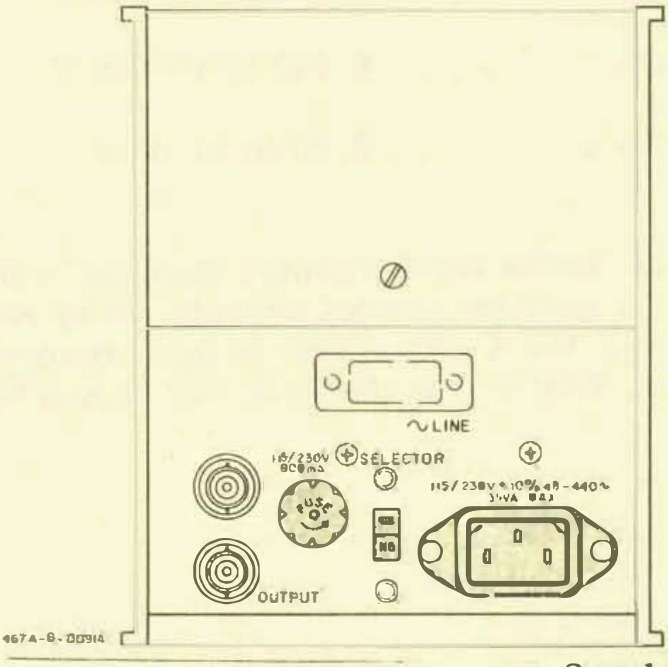
Page 5-13/5-14, Figure 5-14:
Change C7, C8 to .005 uF

Page 6-6, Table 6-1:
Change C7, C8 Part No. to 0160-3333 (5000 pF).
Change F1 Part No. to 2110-0336.

Page 6-7, Table 6-1:
Change J5 Part No. to 1251-2357.
Change S2 Part No. to 3101-1234.
Change W1 Part No. to 8120-1348.

Page 6-8, Table 6-1:
Change rear panel Part No. to 00467-00203.

Page 3-3, Figure 3-2:
Revise rear panel drawing as follows:



CHANGE #2

Page 6-2:

Change A1CR114 Part No. and description to 1901-0050 Diode: Si 200 ma.

CHANGE #3

On the following pages and figures the ground symbols will be changed as shown unless otherwise noted.

 is changed to  .

 is changed to  .

 on the printed circuit boards is changed to  .

Front cover.
Page 1-0.
Figures 3-1, 4-1, 5-13.
Figure 5-14 (do not change earth ground from center terminal of J5.)

ERRATA

On Performance Check Test Card (Following page 5-10) change the Test Limits for AC Accuracy and Gain Check for VAR-CW as follows:

100 kHz	Limits
VAR-CW	9.900 to 10.100 V
10 kHz	
VAR-CW	9.970 to 10.030 V
400 Hz	
VAR-CW	9.970 to 10.030 V
1 MHz	
VAR-CW	9.00 to 11.00 V

Table 5-2:

In the "Model 3440A/3445A AC Voltmeter Reading" column the readings for the VAR-CW position are not correct. They should be the same as the values for the X 10 position in their respective rows, e.g. The reading for VAR-CW in the first row should be 9.900 to 10.100 V.